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Summer Scotian Shelf and Bay of Fundy Research Vessel Survey Update for 2007

Mise à jour sur le relevé d'été de 2007 effectué par un navire de recherche sur le plateau néo-écossais et dans la baie de Fundy

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TABLE OF CONTENTS

Abstract / Résumé iv

Introduction 1

Sampling of Trawl Catch 1

Hydrographic Observations 2

Trawl Mensuration 2

Results 2

- Non-standard Samplling 3
- Notes on Distribution, Abundance, and Condition of Sampled Species 3
- Individual Species Trends 5
- Bottom Temperature and Salinity 9

Conclusions 9

Tables 5

- Table 1 5
- Tables 2-35 9

Figures 17

ABSTRACT

The 2007 Scotian Shelf summer Research Vessel (RV) survey was conducted between July 7th and August 2nd 2007 onboard the *CCGS Teleost*. The *CCGS Teleost* made 77 fishing sets during the first leg of the survey, and 114 during the second leg. In Northwest Atlantic Fisheries Organization (NAFO) divisions 4X5Y (Strata 470-495), 68 valid tows were completed, while 109 valid tows were completed in NAFO divisions 4VW, (Strata 440-466) and 3 sets were completed in Strata 496-498 (Scotian Shelf edge; depth > 200 fm, Fig. 1). Hydrographic data were collected at all fishing stations.

There were 97 species of fish identified from the trawl catch, and 107 species of invertebrates. The number of invertebrate species in 2007 was significantly higher than in the past. This was a result of a broader sampling strategy, and was accomplished through the participation in the survey of personnel with a broad experitise in identification of invertebrates.

Details on data collected, protocols followed, areas covered and species captured are provided. Trends in abundance, biomass, and area occupied are presented for selected commercial species, and for species for which the data display a pronounced trend.

RÉSUMÉ

Le relevé d'été de 2007 effectué par un navire de recherche (NR) sur le plateau néo-écossais a été mené entre le 7 juillet et le 2 août 2007 à bord du navire de la Garde côtière canadienne *(NGCC) Teleost*. Le *Teleost* a jeté 77 filets de pêche à l'eau pendant la première partie du relevé et 114 durant la deuxième. Dans la division 4X5Y (strates 470 à 495) de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO), 68 traits valides ont été réalisés, alors que 109 l'ont été dans la division 4VW (strates 440 à 466) et trois calées dans les strates 496 à 498 (bordure du plateau néo-écossais; profondeur >200 brasses, fig. 1). En outre, des données hydrographiques ont été recueillies à toutes les stations de pêche.

Quatre-vingt-dix-sept (97) espèces de poissons et 107 espèces d'invertébrés ont été prises. Le nombre d'espèces d'invertébrés pris en 2007 est beaucoup plus élevé que par le passé, ce qui s'explique d'une part par la stratégie d'échantillonnage plus vaste et, d'autre part, par la participation au relevé de membres du personnel possédant une plus grande expertise dans l'identification des invertébrés.

Des détails sur les données recueillies, les protocoles suivis, les zones couvertes et les espèces prises sont fournis. De plus, des tendances relatives à l'abondance, à la biomasse et à la zone occupée sont présentées pour certaines espèces commerciales et les espèces pour lesquelles les données montrent une tendance prononcée.

INTRODUCTION

The DFO summer research vessel (RV) survey of the Scotian Shelf and Bay of Fundy has been conducted annually since 1970. The survey follows a stratified random sampling design, and includes both hydrographic sampling and sampling of fish and invertebrates using a bottom otter trawl. These survey data are the primary data source for monitoring trends in species distribution, abundance, and biological condition within the region, and also provide data to the Atlantic Zonal Monitoring Program (AZMP) for monitoring hydrographic variability. This document is intended to provide a synopsis of the findings of the 2007 survey and to examine these data in the context of long-term survey results.

The survey area has been divided into 3 zones, based on oceanography and biogeography. Trends are shown for the entire survey area, and also for 3 separate regions: Eastern Scotian Shelf (NAFO divs. 4VW; Strata 440-466), Western Scotian Shelf (NAFO Div. 4X east; Strata 470-481), and Gulf of Maine/Bay of Fundy (4X west; Strata 482-495). Differences in patterns of fish abundance and species composition are apparent for these regions during the survey.

Plots of the size and distribution of catches are provided for selected species, and stratified average catches are compared with past results to provide a general overview of trends in abundance, biomass, and area occupied. For those species where individual fish weights have been collected throughout most of the time series, trends in condition (Fulton's K) are also included.

Data are presented for the major commercial species, for species which comprise a large part of the survey catch, and for species where the 2007 catch was either unusually high or low. The set of species examined to determine if catches in 2007 were unusual was restricted to those where the area occupied exceeded 7000 square nautical miles (approximately $1/7^{th}$ of the surveyed area) in 2007, or averaged greater than this in the 1970's, the 1980's, or the 1990's. The species examined were restricted in this manner to avoid rare species for which catches display high inter-annual variability.

Comparisons of stratified length frequencies for 2006 and 2007 to the long-term mean are also included for major commercial fish species. These data were summarized to assist in reviewing trends in abundance, which are directly relevant to fisheries management when they are developing advice on allowable catch; hence, these data are grouped by the applicable stock management areas for each species.

SAMPLING OF TRAWL CATCH

Basic data, total numbers and weight caught, and length frequencies were collected from all successful sets according to instructions in the Groundfish Bottom Trawl Surveys Manual.

Length stratified samples for individual fish weight, one per centimeter (by sex if required), were taken from each set for all fish species. In addition, otoliths were taken from cod, haddock, pollock, white hake, silver hake, cusk, halibut, and herring. Maturity stages were assigned for silver hake, cusk, halibut, and herring. All sampling and set information were entered directly in a database with online data editing using an Oracle-based data entry system (GSE).

HYDROGRAPHIC OBSERVATIONS

At all successfully fished stations, profiles of temperature, conductivity (salinity), oxygen concentration, fluorescence, and irradiance (PAR extinction) were obtained with a SBE-25 CTD fitted on a Carousel Rosette deployed by the *CCGS Teleost*. Niskin bottles attached to the Rosette collected water from the bottom, 25 m (intermediate depth) when possible, and from 5 m (near surface) for the following sampling:

- 5m: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2),
- 25m: nutrients (x2), chlorophyll-a (x2), and
- Bottom: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2).

Oxygen measurements were performed after the CTD cast using an ORION 842 bench meter. Salinity determinations were made using a Guildline salinometer. Chlorophyll-a samples were processed onboard with a Turner-Designs fluorometer.

Surface temperatures were measured using a VEMCO SEATEMP temperature probe, and VEMCO depth/temperature miniloggers were attached to the trawl to monitor bottom water temperature.

Additional sampling was undertaken for the AZMP. At 35 selected stations, vertical zooplankton tows (76 and 202 micron mesh) were made from bottom to surface. The Halifax hydro station was occupied 3 times during the course of the mission. On each occasion the following sampling was done:

- Vertical CTD profile of the entire water column (including a fluorometer and dissolved oxygen probe),
- Two vertical zooplankton net tows from bottom to surface (with flow meter); one with each of the 76 and 202 micron nets,
- Secchi depth measurement, and
  Niskin bottle samples at 10 depths through the water column; samples analyzed for oxygen, nutrients, salinity, chlorophyll-a, and phytoplankton.

TRAWL MENSURATION

Scanmar sensors were used to document the trawl characteristics. Wing spread, door spread, headline height, and clearance were all recorded for sets when possible.

RESULTS

The annual DFO research vessel survey of the Scotian Shelf and Bay of Fundy was conducted on the *CCGS Teleost* between July 7th and August 2nd, 2007. The *Teleost* made 191 fishing sets during the survey. This is the lowest number completed since 1988. Overall, 9 tows were designated as unrepresentative (type 3), either due to net damage or because tow duration was less than 20 minutes. In NAFO divs. 4X5Y (Strata 470-495), 68 valid tows were completed, while 109 valid tows were completed in 4VW (Strata 440-466), and 3 sets were completed in Strata 496-498 (Scotian Shelf edge; depth > 200 fm) (Fig. 1).

The beginning of the survey was delayed due to mechanical problems on the vessel. Two additional days were added at the end of the survey, which allowed us to ensure some coverage for most strata. Difficulties in finding suitable bottom for setting the gear resulted in several sets being dropped along the shelf edge and time constraints did not allow for alternative locations to be identified. As a result, no sets were completed in Stratum 496, and only 1 set was conducted in Stratum 497. In Stratum 466, only 1 tow was completed as well. A second station was fished; however, it was moved from the originally selected location and was unfortunately conducted in Stratum 453.

In addition, freezer space was limited due to compressor problems in the walk-in freezer. The ship's Captain purchased two chest freezers to provide some freezer space, and a third chest freezer was brought onboard from the Bedford Institute of Oceanography (BIO). The limited freezer space led us to collect otoliths from herring at-sea rather than freezing them. We were fortunate to have a sampler who was familiar with the extraction technique for herring onboard.

There were 97 species of fish recorded during the survey (Table 2). The most frequently captured fish were American plaice, haddock, silver hake, witch flounder, and cod, while those contributing most to the weight caught were spiny dogfish, haddock, redfish, pollock, and cod.

There were 107 separate invertebrate codes used during the survey (Table 3). This is substantially greater than in 2006 when 63 invertebrate species were recorded. This was a result of a broader sampling strategy, and was accomplished through the participation in the survey of personnel with a diverse expertise in identification of invertebrates. The most frequently captured were short-fin squid, pink shrimp (*Pandalus montagui*), starfish (*Asteroidea S.C.*), and sponges, while sea cucumbers, northern shrimp (*Pandalus borealis*), and American lobster contributed most to the weight of the invertebrate catch.

Identification of all corals was verified in the lab at BIO immediately following completion of the survey. Those which were listed as unidentified at-sea had the correct species designation added to the database. A large collection of invertebrates, along with a smaller number of unidentified fish, were delivered to the Atlantic Reference Centre (ARC) for identification. No identifications are available for these specimens yet. Most of these specimens were photographed during the survey, and if identifications are available prior to the next survey, these photographs will be annotated and provided as guides to identification at-sea.

Non-standard Sampling

A variety of samples were collected in addition to those required as part of our standard sampling protocols (Table 2). Herring otoliths were collected due to the lack of sufficient freezer space to save whole fish. Identification of stomach contents was conducted at-sea. The *CCGS Teleost* has additional cabin space for science staff, which allowed us to take an additional person for each watch to analyze stomach contents. This additional cabin space also allowed us to fulfill a request from the Canadian Wildlife Service (CWS), providing them with accommodation for staff to conduct a seabird survey for the duration of the trip.

Notes on Distribution, Abundance, and Condition of Sampled Species

Individual distribution, biomass, and condition trend plots are included for some of the major fish and invertebrates in the survey catch (tables 2 and 3; figs. 4 to 34) and for other species of commercial importance. This includes haddock, redfish, sea cucumber, and American lobster.

Data are examined for species which were noted during the 2007 survey as more common than recent years, such as halibut, American lobster, and black belly rosefish, or as unusually scarce, such as argentine. In addition, an exploration of survey time series data indicates that recent large changes in area occupied were found for northern sand lance, halibut, and argentine. Length composition charts for those species with sufficient data are also presented. A general impression gleaned during the 2007 survey was that catches were improving in 4VW, but that, aside from dogfish, catches were low in 4X east and 4X west.

Total biomass estimate for the Scotia-Fundy summer RV survey is displayed in Figure 2a. Data was not traditionally collected on all species; therefore, this estimate is restricted to all vertebrate species, plus lobster and squid. There was a large decline in catch in 4VW from 1985 to 1995. The total biomass estimate for 4X is variable, but does not show a significant change over the time series. This estimate can be heavily influenced by a small number of species. For example, a large catch of dogfish from 4X east in 2007 resulted in the highest biomass estimate for this area in the time series.

An average relative biomass trend was also calculated for commercial groundfish to see if there is any general trend among species in each area. Data were included for cod, haddock, pollock, white hake, red hake, Atlantic wolffish, monkfish, witch flounder, silver hake, and redfish. Annual biomass estimates for each species were divided by the average biomass for the time series to derive a relative biomass for each species. The relative biomass series were then averaged across these species to derive an average relative biomass index for each area (Fig. 2b).

The decline in average relative biomass (ARB) over the time series is apparent for all areas. In 4VW, ARB was high until the mid-1980's, then declined steeply. This pattern is not as clear for 4X east and 4X west. ARB displayed more inter-annual variability in these areas, but shows a clear declining trend starting in the 1980's. In the last 3 years, the trend seems to have reversed in 4VW, and ARB is increasing. This has not occurred in 4X east or 4X west, where ARB remains near its lowest levels.

Average condition was also compared for all regions of the Scotia-Fundy summer survey (figs. 3a, 3b, 3c). Condition (Fulton's K) was averaged across all species for which data are available.

There is a general decline in condition for all areas. Condition declined earlier in 4VW, following a declining trend from about 1980 to 2000, but may be improving since 2004 (Fig. 3a). Average condition was low in 4X east in the mid-1980s, recovered, then dropped in 1993, and has remained at a low level (Fig. 3b). In 4X west, condition was variable prior to the early 1990s, declined around 1993, and has remained low (Fig. 3c). Condition was at its lowest in the series for all areas in 2004.

Recent increases in Average Condition and Average Relative Biomass for 4VW are consistent with observations from the surveys that catches seem to be improving. The lack of any improvement in 4X is consistent with the impression held by those at-sea during the survey that catches of commercial fish were generally low in both 4X east and 4X west.

Individual Species Trends

Table 1. Index of individual species summaries and associated figures.

Species	Summary page	Figure page
Pollock (*Pollachius virens*)	5	20
Haddock (*Melanogrammus aeglefinus*)	5	23
Atlantic Cod (*Gadus morhua*)	6	27
White Hake (*Urophycis tenuis*)	6	31
Silver Hake (*Merluccius bilinearis*)	6	35
Redfish (*Sebastes sp.*)	6	38
Halibut (*Hippoglossus hippoglossus*)	6	41
Winter Flounder (*Pseudopleuronectes americanus*)	7	44
American Plaice (*Hippoglossoides platessoides*)	7	47
Witch Flounder (*Glyptocephalus cynoglossus*)	7	50
Spiny Dogfish (*Squalus acanthias*)	7	53
Winter Skate (*Leucoraja ocellata*)	7	55
Thorny Skate (*Amblyraja radiata*)	7	56
Herring (*Clupea harengus*)	7	58
Argentine (*Argentina silus*)	7	60
Turbot (*Reinhardtius hippoglossoides*)	7	62
Monkfish (*Lophius americanus*)	8	64
Striped Wolffish (*Anarhichas lupus*)	8	64
Blackbelly Rosefish (*Helicolenus dactylopterus*)	8	65
Sand Lance (*Ammodytes dubius*)	8	65
Red Hake (*Urophycis chuss*)	8	66
Cusk (*Brosme brosme*)	8	66
Ocean Pout (*Macrozoarces americanus*)	8	67
Hagfish (*Myxine glutinosa*)	8	67
Short-fin Squid (*Illex illecebrosus*)	8	68
Lobster (*Homarus americanus*)	8	69
Snow Crab (*Chionoecetes opilio*)	8	70
Pandalus montagui	8	71
Pandalus borealis	8	71
Sea Scallop (*Placopecten magellanicus*)	8	72
Sea Cucumber (*Holothuroidea c.*)	8	73

Most **pollock** in the 2007 summer RV survey were caught in the Gulf of Maine and near the 4X – 4W line, with some also along the Laurentian Channel (Fig. 4a). Biomass estimates are higher than in most recent years in 4VW and 4X west, but remain low in eastern 4X (Fig. 4b). Pollock condition declined for in all regions of the survey in the early 1990's, and has remained low but stable since then (Fig. 4e). Abundance is high at most commercial lengths in the western assessment unit, but there is little indication of recruitment (Fig. 4c). High numbers in the eastern assessment unit (4VW and 4Xn) in 2007 likely reflect 2 year-classes, and there is no indication of recruitment following these (Fig. 4d).

Catches of **haddock** were well distributed across the eastern and central Scotian Shelf, although catches were poor in the Bay of Fundy and Gulf of Maine (Fig. 5a). Biomass increased in all areas after the early 1990's. Biomass had dropped to a recent low in 2005 in 4VW, but

increased in 2006 and remains high in 2007. In 4X east, biomass is about average with no recent trend. In 4X west, biomass was among the lowest in the series in both 2004 and 2005 (Fig. 5b). It has increased in 2007, but remains below average. Two modes appear in the 4VW length composition, and numbers are well above average at most lengths less than 43 cm (Fig. 5c). Div. 4X east is also showing good numbers below 50 cm (Fig. 5d). In 4X west, ages 0 (8.5 cm) and 1 (22.5 cm) were abundant for 2006, but there are no signs of recruitment in this area for 2007 (Fig. 5e). Few large haddock were seen in any of the areas for 2007. Condition of haddock declined earlier on the shelf than in Bay of Fundy, but condition factor has been improving for all areas in recent years (Fig. 5f).

While **cod** catches were widespread in the survey area, there were few large catches. The largest catches by weight were in 4V, and several sets with high numbers of small fish came from Western Bank (Fig. 6a). Biomass remains low in all areas, but 4VW is showing sign of increase (Fig. 6b). Number of cod caught in 4Vn was well below average for all lengths greater than 40 cm (Fig. 6c), and although a strong year-class can be seen in 4VsW in both 2006 and 2007, numbers remain very low above 43 cm (Fig. 6d). Numbers are very low for commercial sized fish throughout 4X. Numbers are also low for smaller cod, indicating that recruitment remains poor (figs. 6e, 6f). Cod condition has fluctuated without trend in the Bay of Fundy, but shows recent decline in eastern 4X. Condition is improving in 4VW, although it remains lower than in the 1970's (Fig. 6g).

White hake were caught throughout the survey area, but there were no sets above 50 kg (Fig. 7a). Biomass has declined since the last assessment (2005), and is near the lowest in the survey series for all areas (Fig. 7b). Numbers at length were below average for almost all lengths in 4VW (Fig. 7c) and 4X (figs. 7d, 7e). Numbers at length are generally much higher in 4X west than in 4X east. In 2006 and 2007, the numbers in 4X west are very low for all lengths, except those near 25cm. Condition has been lower in all regions since 1995 than earlier in the series. There is some indication of an increase in 2006 and 2007 in 4VW (Fig. 7f).

Catches of **silver hake** in the 2007 survey were widespread, with the exception of the Eastern Shelf (Fig. 8a). Biomass remains low for the entire survey area despite an increase for 4X west in 2007 (Fig. 8b). The strong age 1 year-class seen in 2006 does not appear to have carried through to age 2 in 2007 (Fig. 8c). The mode of age 1 fish (about 17 cm) is above average in 2007, but numbers are well below average for lengths above 25 cm. Condition of silver hake declined in all areas during the early 1990's. There has been some recent improvement in 4X east where the decline was steepest, but it remains low in 4X west and 4VW (Fig. 8d).

Redfish are well distributed throughout the survey area, with larger sets coming primarily from 4V and eastern 4X (Fig. 9a). Biomass remains low in 4VW, while estimates are quite variable in 4X. Biomass increased slightly in 4X east for 2006 and 2007, but declined to about average in the west in 2007 (Fig. 9b). Numbers were high for smaller redfish in both 2006 and 2007 for Redfish Area 3 (Fig.9c), and numbers were also high for smaller fish in the surveyed portion of Area 2 (Fig. 9d). Although numbers of larger fish in both areas were at or above average for 2006, they were below average for 2007. Since 1995, redfish condition has been low in all regions (Fig. 9e), but has increased in 4X west in the last 3 years.

Halibut were widely caught in 4X and 4VW (Fig. 10a). Biomass (Fig. 10b) and stratified area occupied (Fig. 10c) have both been increasing since about 2000, and reached the highest in the series in 2007. Length composition of halibut was well above average for most lengths in both 2006 and 2007 (Fig. 10d). There is no clear trend in condition for halibut (Fig. 10e).

Winter flounder were caught in the Bay of Fundy, Brown's Bank, and Western Bank, with the largest catches coming from the Bay (Fig. 11a). Biomass in 4VW is low (Fig. 11b). In eastern 4X, biomass has declined recently but remains higher than in years before 1987. Biomass remains high in western 4X. Numbers are very high for smaller flounder in both eastern (Fig. 11c) and western (Fig. 11d) 4X, with some indication of a strong year-class coming in 4X west. Numbers are very low in both areas for larger fish. Condition has been declining in all regions, but has recently shown an increase in 4X (Fig. 11e).

American plaice are widespread on the Scotian Shelf, but large catches come primarily in 4V (Fig. 12a). Biomass remains low in 4X and shows no pronounced trend in 4VW since 1995, but remains low compared to the 1970's and 1980's (Fig. 12b). Numbers at length are near average for American plaice in 4VW (Fig. 12c). In western 4X, condition has fluctuated without trend, while condition has declined since 2000 in eastern 4X and remains low. In 4VW, condition has been trending lower since about 1990, but has increased in 2006/07 and is about average (Fig. 12d).

The largest catches of **witch flounder** came from 4V, with no large catches in 4X (Fig. 13a). Biomass has followed an increasing trend in 4VW since the early 1990's, while biomass remains low in western 4X and shows little trend in eastern 4X (Fig. 13b). Numbers of witch are well above average at most lengths below 40 cm in 4VW (Fig. 13c). Catch of small witch suggests a good year-class may be coming. High abundance in 4X is restricted to eastern 4X (Fig. 13d). Abundance is low in western 4X for most lengths (Fig. 13e). Larger witch have been a major part of the population in western 4X, but are completely absent in 2006 and 2007. Condition remains low in all areas, but has shown recent increase (Fig. 13f).

Spiny dogfish were caught only in 4X in 2007 (Fig. 14a). Several large tows were taken from the Bay of Fundy and areas around Brown's Bank. The single largest tow in the survey series was caught in 2007 west of Brown's Bank. Biomass estimates for dogfish are quite variable, and in 2007, the survey catch was among the highest (Fig. 14b). There is no clear trend in condition for dogfish (Fig. 14c).

Catches of **winter skate** were low in 2007 (Fig 15a). There has been a continuing decline in biomass, and the 2007 estimate is the lowest in the series (Fig. 15b).

The largest catches of **thorny skate** came from 4V (Fig. 16a). Thorny skate biomass in 4X appears stable at a low level. Biomass in 4VW increased from a low recorded in 2002, but remains at a low level (Fig. 16b). Condition is variable without a clear trend (Fig. 16c).

Herring catches were concentrated mainly on the Western Shelf and in the Bay of Fundy (Fig. 17a). Biomass estimates declined in all areas except 4X west in 2007 (Fig. 17b). Condition increased for herring in all areas, and is near the average for the time series (Fig. 17c).

Argentine were caught in very few tows (Fig. 18a) and both biomass (Fig. 18b), and area occupied (Fig. 18c) has shown a decline since mid-1990's. It is not clear if survey catches are reflecting population biomass trends for either herring or argentine. These species are primarily pelagic, and small changes in vertical distribution may strongly influence bottom trawl catches.

Turbot catches in 2007 came from 4V and the Shelf edge (Fig. 19a). Biomass estimates have increased ten-fold since 1990, and, despite a recent decline, estimates remain relatively high (Fig. 19b). Area occupied has also been increasing consistently and remains among the highest in the series (Fig. 19c).

There were few **monkfish** or **striped wolffish** caught in 2007. Monkfish biomass appears low but stable in all regions (Fig. 20), while wolffish biomass continues to decline, and is the lowest in the series (Fig. 21).

The biomass of **Black Belly Rosefish** declined from 2006 to 2007, but remains very high (Fig. 22).

Sand Lance biomass has foilowed a declining trend since 2000, but remains above average for the series in 2007 (Fig. 23). The catch of sand lance comes entirely from 4VW.

Biomass of **Red Hake** increased slightly from 2006, but still shows a declining trend since the mid-1990's (Fig. 24).

Cusk catches have declined throughout the series, but appear to have stabilized at a low level in recent years (Fig. 25).

Ocean pout biomass estimates declined to a low level in 2003, but have since shown a slight increase (Fig. 26). The overall increase reflects an increase in 4X west, while biomass remains low in 4VW.

Estimates of **hagfish** biomass have been variable, and in recent years have increased in western 4X while showing a decrease in 4VW (Fig. 27).

Short-fin squid are widespread in the survey area, with the largest catches coming from near the Shelf edge (Fig. 28a). Survey catch shows high inter-annual variability, and is about average in 2007 (Fig. 28b).

Lobster was caught in most sets in 4X but rarely in 4VW (Fig. 29a). Lobster biomass remains very high overall, but has declined recently in 4X west (Fig. 29b).

Snow crab was caught in most sets east of Western Bank, but in only one set in 4X (Fig. 30a). Snow crab has a much shorter time series available, but biomass appears to be stable (Fig. 30b).

Most invertebrates in the catch also have a shorter time series (1999-present). ***Pandalus montagui*** (pink shrimp) (Fig. 31) is distributed throughout the survey area, while ***P. borealis*** (northern shrimp) (Fig. 32) is caught primarily in 4VW. Biomass estimates for both species have not shown a major change in the time series.

Sea scallop catches were distributed mainly in 4WX, with largest catches coming from 4X near Brown's Bank and in the Bay of Fundy (Fig. 33a). 4VW catches vary without trend. The biomass estimate for 4X west has declined over the time series and remains low in 2007. Overall Scallop biomass estimates appear to show recent stability (Fig. 33b).

Sea cucumber was distributed throughout the survey area, but largest catches by weight came from Middle Bank, near Sable Island, and Banquereau (Fig. 34).

Bottom Temperature and Salinity

Temperature and salinity data were collected at each station from the 2007 survey. Contour plots of these data show general patterns of water masses in the region (Fig. 35a, 35b). The general patterns are consistent with past years in that the Eastern Scotian Shelf had cold water, the central shelf had warm saline water, and the inner Bay of Fundy had mainly warm water of low salinity. Warm, high salinity water was also found in the Georges Basin area.

CONCLUSIONS

The objectives for the 2007 survey were successfully completed, despite having the lowest number of valid tows since 1988. The survey data are available on Divisional data bases for more detailed analyses.

Increased effort on identification of invertebrates has resulted in a much higher number of invertebrate species recorded. Further development of field identification guides is needed to ensure these species can be recorded consistently on future surveys.

Examination of condition data shows there has been a fairly general decline in condition across species in all areas covered by the survey. While the average condition among species remains low in 4X, there has been some increase in 4VW from the low value seen in 2004.

The total biomass observed in the survey has declined over time in 4VW, but has varied without trend in 4X. Average Relative Biomass (ARB) calculated for a suite of commercial groundfish shows some recent increase in 4VW. In 4X, ARB shows a long-term decline, and there is no indication from this index of any general improvement in biomass for these species in 4X.

Table 2. Special sampling conducted during the 2007 Scotia-Fundy summer RV survey.

Hagfish	68 whole fish collected
Herring	182 sets of otoliths collected
Whole specimens for schools	10 samples collected for each of 30 species
Whole cod and haddock < 28 cm	6 haddock and 6 cod collected
Stomach samples	2819 stomachs taken from 31 species; 357 additional small fish retained for analysis at BIO
Barndoor Skate (DNA)	tissue samples taken from 13 fish
Cusk (DNA)	tissue samples collected for 15 fish
Little skate<40 cm	25 fish collected
Thorny skate<25 cm	15 fish collected
Winter skate <40cm	25 fish collected
Winter skate (DNA)	40 tissue samples collected
Capelin (DNA)	100 fish collected
Cod (DNA)	tissue samples collected from 150 cod
Whole fish for ROM	2 specimens each of 20 species collected
Seabird survey	Canadian Wildlife Service (CWS) seabird survey conducted for entire duration of the trip

Table 3. Summary of fish catch from the 2007 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
40	American Plaice	Hippoglossoides platessoides	126	651.042	3677	
11	Haddock	Melanogrammus aeglefinus	102	5920.169	12325	1624
14	Silver Hake	Merluccius bilinearis	97	719.491	11966	1232
41	Witch Flounder	Glyptocephalus cynoglossus	95	273.442	1542	
10	Cod (Atlantic)	Gadus morhua	90	1907.186	2803	533
23	Redfish, Unseparated	Sebastes Sp.	84	4176.701	32412	
60	Herring (Atlantic)	Clupea harengus	82	822.988	6055	182
42	Yellowtail Flounder	Limanda ferruginea	67	673.314	4088	
300	Longhorn Sculpin	Myoxocephalus octodecemspinosus	66	262.905	1789	
12	White Hake	Urophycis tenuis	63	356.14	700	404
201	Thorny Skate	Amblyraja radiata	61	291.206	591	
320	Sea Raven	Hemitripterus americanus	50	215.075	335	
610	Northern Sand Lance	Ammodytes dubius	50	333.921	18632	
13	Squirrel or Red Hake	Urophycis chuss	45	41.555	241	
30	Halibut (Atlantic)	Hippoglossus hippoglossus	40	325.358	90	87
16	Pollock	Pollachius virens	36	2515.433	1487	208
43	Winter Flounder	Pseudopleuronected americanus	36	218.266	752	
50	Striped Atlantic Wolffish	Anarhichas lupus	34	40.3418	130	
220	Spiny Dogfish	Squalus acanthias	34	12462.523	7437	
340	Alligatorfish	Aspidophoroides monopterygius	33	0.316	158	
31	Turbot, Greenland Halibut	Reinhardtius hippoglossoides	32	176.606	353	
400	Monkfish, Goosefish, Angler	Lophius americanus	29	67.395	65	
304	Mailed Sculpin	Triglops murrayi	28	3.4	304	
202	Smooth Skate	Malacoraja senta	27	20.21	62	
241	Northern Hagfish	Myxine glutinosa	27	3.286	68	
62	Alewife	Alosa pseudoharengus	25	36.236	312	
640	Ocean Pout (Common)	Macrozoarces americanus	24	17.654	82	
112	Longfin Hake	Urophycis chesteri	21	12.115	154	
64	Capelin	Mallotus villosus	17	10.004	1554	
203	Little Skate	Leucoraja erinacea	17	89.021	191	
647	Shorttailed Eelpout (Vahl)	Lycodes vahalii	17	19.732	226	
204	Winter Skate	Leucoraja ocellata	16	43.62	41	
410	Marlin-Spike Grenadier	Nezumia bairdii	16	3.047	114	
623	Daubed Shanny	Lumpenus maculatus	16	3.249	636	
123	Rosefish (Black Belly)	Helicolenius dactylopterus	15	67.94	605	
114	Fourbeard Rockling	Enchelyopus cimbrius	11	0.712	16	

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
350	Atlantic Sea Poacher	Leptagonus decagonus	11	0.613	33	
622	Snake Blenny	Lumpenus lumpretaeformis	11	2.828	105	
880	Hookear Sculpin (Atlantic)	Artediellus atlanticus	11	0.071	22	
200	Barndoor Skate	Dipturus laevis	10	87.22	16	
323	Hookear Sculpin (NS)	Artediellus sp.	10	0.26	77	
150	Lanternfish (NS)	Myctophidae	9	2.633	959	
502	Atlantic Spiny Lumpsucker	Eumicrotremus spinosus	9	0.19	18	
160	Argentine (Atlantic)	Argentina silus	8	61.323	199	
625	Radiated Shanny	Ulvaria subbifurcata	8	0.199	18	
61	Shad American	Alosa sapidissima	7	15.596	23	
712	White Barracudina	Notolepis rissoi	7	2.032	141	
15	Cusk	Brosme brosme	6	20.459	14	13
70	Mackerel (Atlantic)	Scomber scombrus	6	8.563	62	
619	Eelpout, Newfoundland	Lycodes terraenova	6	4.648	30	
701	Butterfish	Peprilus triacanthus	6	1.419	20	
19	Off-Shore Hake	Merluccius albidus	5	16.23	12	
159	Boa Dragonfish	Stomias boa	4	3.752	181	
221	Black Dogfish	Centroscyllium fabricii	4	5.708	39	
646	Atlantic Soft Pout	Melanostigma atlanticum	4	0.193	27	
44	Gulf Stream Flounder	Citharichthys arctifrons	3	0.135	5	
314	Spatulate Sculpin	Icelus spatula	3	0.047	10	
500	Seasnail, Unidentified	Liparis sp.	3	0.013	6	
501	Lumpfish	Cyclopterus lumpus	3	1.601	3	
602	Gray's Cutthroat Eel	Synaphobranchus kaupi	3	0.71	30	
620	Laval's Eelpout	Lycodes lavalaei	3	1.125	3	
17	Tomcod (Atlantic)	Microgadus Tomcod	2	1.362	12	
149	Longnose Greeneye	Parasudis truculenta	2	0.04	3	
169	Viperfish	Chauliodus sloani	2	0.11	3	
176	Goitre Blacksmelt	Bathylagus euryops	2	0.037	2	
240	Sea Lamprey	Petromyzon marinus	2	0.106	2	
286	Benthosema sp.	Benthosema sp.	2	0.031	6	
301	Shorthorn Sculpin	Myoxocephalus scorpius	2	0.42	3	
303	Grubby or Little Sculpin	Myoxocephalus aenaeus	2	0.006	3	
341	Arctic Alligatorfish	Aspidophoroides olriki	2	0.003	2	
601	Snubnose Eel, Slime Eel	Simenchelys parasitica	2	0.235	5	
604	Snipe Eel	Nemichthys scolopaceus	2	0.076	5	
630	Wrymouth	Cryptacanthodes maculatus	2	0.54	2	
845	Eelpout (NS)	Lycodes eudipleurostictus	2	0.176	3	

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples
39	Black Swallower	Chiasmodon niger	1	0.016	1	
51	Spotted Wolffish	Anarhichas minor	1	9.7	1	
52	Northern Wolffish	Anarhichas denticulatus	1	0.01	1	
122	Cunner	Tautogolabrus adspersus	1	0.3	1	
143	Brill/Windowpane	Scophthalmus aquosus	1	0.295	1	
163	Lanternfish,Horned	Ceratoscopelus maderensis	1	0.003	1	
182	Lanternfish Kroyer's	Notoscopelus elongates kroyeri	1	0.02	2	
211	Skates (NS)	Rajidae F.	1	1.515	1	
308	Pallid Sculpin	Cottunculus thompsoni	1	0.155	1	
414	Rock Grenadier (Roundnose)	Coryphaenoides rupestris	1	0.49	5	
511	Blacksnout Seasnail	Paraliparis copei	1	0.001	3	
512	Seasnail,Dusky	Liparis gibbus	1	0.002	1	
592	Shark (NS)	Shark (NS)	1	75	1	
617	Common Wolf Eel	Lycenchelys paxillus	1	0.008	1	
626	4-Line Snake Blenny	Eumesogrammus praecisus	1	0.074	4	
637	Spotfin Dragonet	Foetorepus agassizi	1	0.04	1	
642	Eelpouts(NS)	Lycodes sp.	1	0.3	1	
700	Atlantic Silver Hatchfish	Argyropelecus aculeatus	1	0.01	1	
709	Transparent Hatchetfish	Sternoptyx diaphana	1	0.002	1	
714	Simonyi's frostfish	Benthodesmus simonyi	1	0.012	1	
727	White Barracudina	Notolepis rissoi	1	0.14	12	
883	Gonostoma bathyphilum	Gonostoma bathyphilum	1	0.136	0	
891	Lampriformes	Lampriformes	1	0.016	1	

Table 4. Summary of invertebrate catch from the 2007 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4511	Short-Fin Squid	Illex illecebrosus	106	250.564	2486
2212	Pandalus montagui (Pink Shrimp)	Pandalus montagui	93	249.9807	127686
6100	Asteroidea S.C. (Starfish)	Asteroidea S.C.	72	22.855	831
8600	Sponges	Porifera P.	71	55.947	142
8300	Sea Anemone	Anthozoa C.	69	35.127	237
2526	Snow Crab (Queen)	Chionoecetes opilio	64	170.563	1340
4200	Snails and Slugs	Gastropoda O.	58	21.783	214
6600	Sea Cucumbers	Holothuroidea C.	55	4077.371	197
6411	Green Sea Urchin	Strongylocentrotus droebachiensis	49	109.129	542
4321	Sea Scallop	Placopectin magellanicus	42	30.21	1866
2527	Toad Crab	Hyas araneus	40	6.721	157
4521	Octopus	Octopoda O.	39	1.498	99
2211	Pandalus borealis (Northern Shrimp)	Pandalus borealis	38	850.365	92222
6119	Blood Star	Henricia sanguinolenta	38	0.834	161
2550	American Lobster	Homarus americanus	36	343.761	236
2560	Paguroidea S.F. (Hermit Crab)	Paguroidea S.F.	36	2.733	95
6115	Mud Star	Ctenodiscus crispatus	35	8.79	299
2521	Lyre Crab	Hyas coarctatus	33	6.8	185
6123	Sun Star	Solaster papposus	33	10.632	138
1224	Skate, Unidentified Eggs	Raja Eggs	32	3.912	102
6110	Asterias sp. (Sea stars)	Asterias sp.	30	13.109	255
6511	Common Sand Dollar	Echinarachnius parma	29	5.967	152
2511	Jonah Crab	Cancer borealis	27	11.079888	62
8500	Jellyfishes	Scyphozoa C.	25	20.408	34
6117	Hippasteria phrygiana	Hippasteria phrygiana	24	12.835	72
2411	Argis dentata	Argis dentata	23	11.847	2856
2513	Atlantic Rock Crab	Cancer irroratus	23	10.689	110
6121	Purple Sunstar	Solaster endeca	23	12.193	59
6200	Brittle Star	Ophiuroidea S.C.	23	31.7434	384
6300	Basket Stars	Gorgonocephalidae, Asteronychidae F.	22	26.264	16
6111	Purple Starfish	Asterais vulgaris	20	34.462	111
1823	Sea Potato	Boltenia sp.	19	13.99	133
2559	Hermit Crabs	Paguridae F.	19	0.879	42

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
3100	Bristle Worms	Polychaeta C.	19	0.168	88
2523	Northern Stone Crab	Lithodes maja	18	9.91	40
4322	Iceland Scallop	Chlamys islandica	16	2.675	44
2416	Crangon sp.	Crangon sp.	15	0.192	245
2990	Barnacles	Cirripedia S.C.	12	11.524	3
4536	Sepiolidae F.	Sepiolidae F.	12	0.203	17
6113	Leptasterias polaris	Leptasterias polaris	12	3.413	47
1810	Tunicata S.P.	Tunicata S.P.	11	7.99	33
2221	Pasiphaea multidentata	Pasiphaea multidentata	11	3.923	2223
3212	Aphrodita sp.	Aphrodita sp.	11	2.16	15
6400	Sea Urchins	Strongylocentrotus sp.	11	1.7	52
8324	Sea Cauliflower, Strawberries	Eunephthya rubiformis	11	0.425	21
2100	Shrimps	Decapoda O.	10	1.326	966
2312	Lebbeus polaris	Lebbeus polaris	10	0.334	486
4514	Squid (NS)	Loliginidae, Ommastrephidae F.	10	0.296	35
6125	Pteraster militaris	Pteraster militaris	10	0.477	15
2310	Spirontocaris	Spirontocaris sp.	8	0.104	110
3200	Sea Mouse	Aphrodita hastata	6	0.149	20
4400	Sea Slugs	Nudibranchia O.	6	0.254	27
6413	Heart Urchin	Brisaster fragilis	6	3.534	6
8318	Sea Pen	Pennatulacea	6	4.636	18
2417	Crangon septemspinosa	Crangon septemspinosa	5	0.0815	71
4500	Cephalopoda C.	Cephalopoda C.	5	0.021	5
8347	Psilaster andromeda	Psilaster andromeda	5	0.525	16
1930	Lampshells	Bryozoans Brachiopoda P.	4	0.035	24
2313	Spirontocaris liljeborgii	Spirontocaris liljeborgii	4	0.056	79
2320	Lebbeus sp.	Lebbeus sp.	4	0.24	200
2415	Pontophilus norvegicus	Pontophilus norvegicus	4	0.105	59
2800	Amphipoda O.	Amphipoda O.	4	0.004	5
4310	Clams (NS)	Protobranchia, Heterodonta	4	0.195	4
5100	Sea Spider	Pycnogonida S.P.	4	0.007	7
8348	Leptychaster arcticus	Leptychaster arcticus	4	0.0496	20
8601	Russian Hats	Vazella pourtalesi	4	9.735	2
1821	Sea Squirts	Ascidia sp.	3	1.37	20
2213	Was Pandalus propinquus	Atlantopandalus propinqvus	3	0.871	291

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
2980	Isopoda O.	Isopoda O.	3	0.007	5
3501	Lepidonotus squamatus	Lepidonotus squamatus	3	0.004	4
8327	Soft Coral Unidentified	Soft Coral Unidentified	3	0.12	7
8530	Sea Corals (NS)	Sea Corals (NS)	3	0.525	0
2200	Pandalidae F.	Pandalidae F.	2	0.015	35
2414	Sclerocrangon boreas	Sclerocrangon boreas	2	0.016	5
2419	Sabinea sarsi	Sabinea sarsi	2	0.01	8
2520	Toad crab,unident.	Hyas sp.	2	0.012	38
2600	Krill Shrimp	Euphausiacea O.	2	0.032	92
4221	Northern Moonsnail	Euspira heros	2	0.044	2
4316	Astarte sp.	Astarte sp.	2	0.022	8
4330	Mussels (NS)	Mytilidae F.	2	0.405	12
6500	Sand Dollars	Clypeasteroida O.	2	0.064	11
8322	Sea Corn	Primnoa resedaeformis	2	27.216	0
8332	Coral (NS)	Anthozoa	2	0.042	1
8335	Cup Coral	Flabellum sp.	2	0.34	25
8349	Lophaster furcifer	Lophaster furcifer	2	0.786	5
1056	Stereomastis sculpta	Stereomastis sculpta	1	0.138	3
1510	Whelk Eggs (NS)	Buccinidae Eggs	1	0.036	0
1932	Terebratulina sp.	Terebratulina sp.	1	0.176	0
2210	Pandalus sp.	Pandalus sp.	1	0.11	5
2219	Pasiphaeidae F.	Pasiphaeidae F.	1	0.614	19
2220	Shrimp	Pasiphaea tarda	1	0.058	21
2223	Sergestes arcticus	Sergestes arcticus	1	1.39	1642
2319	Lebbeus groenlandicus	Lebbeus groenlandicus	1	0.001	0
2400	Crangonidae F.	Crangonidae F.	1	0.003	1
2420	Sabinea sp.	Sabinea sp.	1	0.003	4
2532	Red Deepsea Crab	Chaceon quinquedens	1	4.05	15
2540	Axiidae F.	Axiidae F.	1	0.001	1
2556	Munida valida	Munida valida	1	0.125	6
2610	Euphausiidae F.	Euphausiidae F	1	0.52	7500
2612	Euphausia sp.	Euphausia sp.	1	0.2	550
2981	Aega psora	Aega psora	1	0.001	2
3099	Hyalinoecia CF Tubicola	Hyalinoecia CF Tubicola	1	0.082	13
4210	Whelks	Buccinum sp.	1	0.044	1

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4211	Wave Whelk, Common Edible	Biccinum undatum	1	0.028	1
4300	Bivalvia C.	Bivalvia C.	1	0.01	1
4331	Common Mussels	Mytilus edulis	1	0.056	2
4340	Cockles	Cardiidae F.	1	0.014	2
4560	Pyroteuthis sp.	Pyroteuthis sp.	1	0.07	2
6101	Ceremaster granularis	Ceremaster granularis	1	0.026	9
6120	Henrica sp.	Henrica sp.	1	0.026	
6201	Ophiacantha abyssicola	Ophiacantha abyssicola	1	0.033	
6213	Ophiura sarsi	Ophiura sarsi	1	0.244	2
8326	Acanthogorgia armata	Acanthogorgia armata	1	0.033	
8328	Anthomastus grandiflorus	Anthomastus grandiflorus	1	1.65	0
8346	Pseudarchaster parelii	Pseudarchaster parelii	1	0.04	2
8405	Garland hydroids	Sertularia sp.	1	0.001	0
8520	Jellyfish	Pelagia noctiluca	1	0.036	0
8610	Polymastia sp.	Polymastia sp.	1	0.008	0

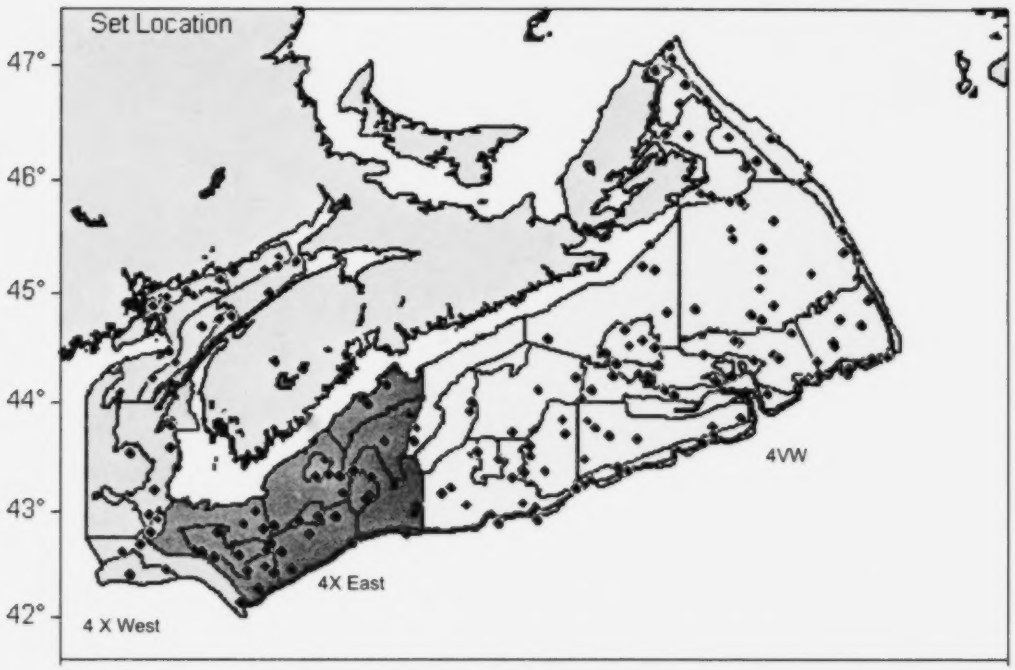

Figure 1. Station locations and geographical zones from the 2007 Scotia-Fundy summer RV survey (Blue=4X West, Green=4X East, Yellow=4VW).

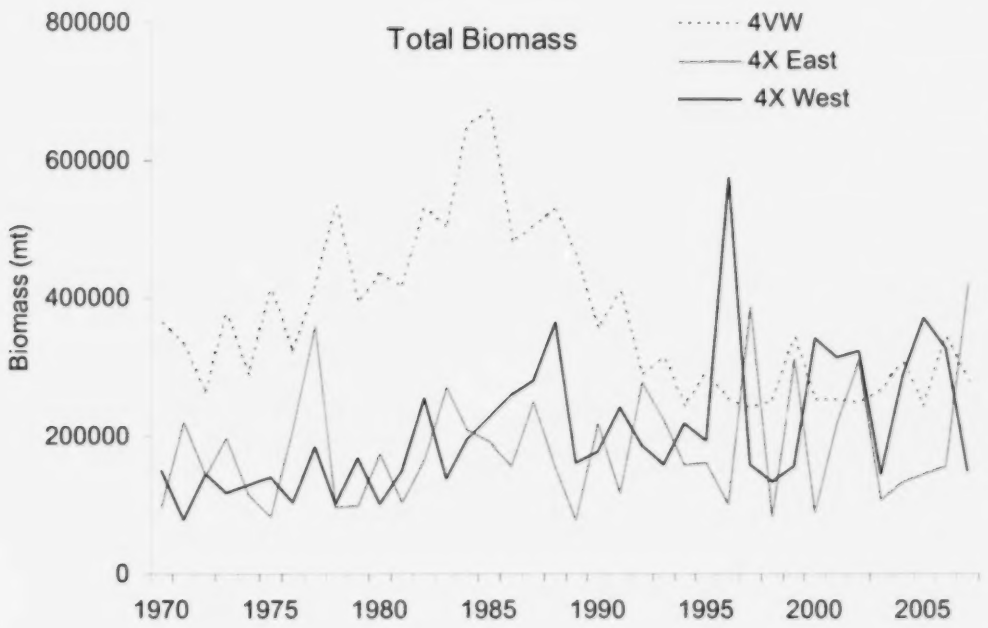

Figure 2a. Total biomass estimate from the Scotia-Fundy summer RV survey.

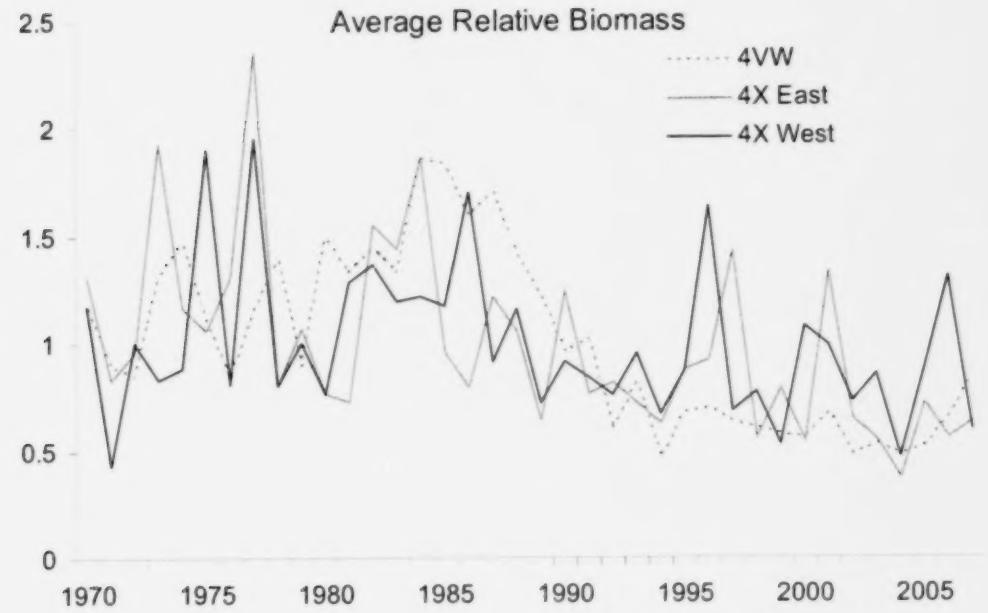

Figure 2b. Average relative biomass from the Scotia-Fundy summer RV survey.

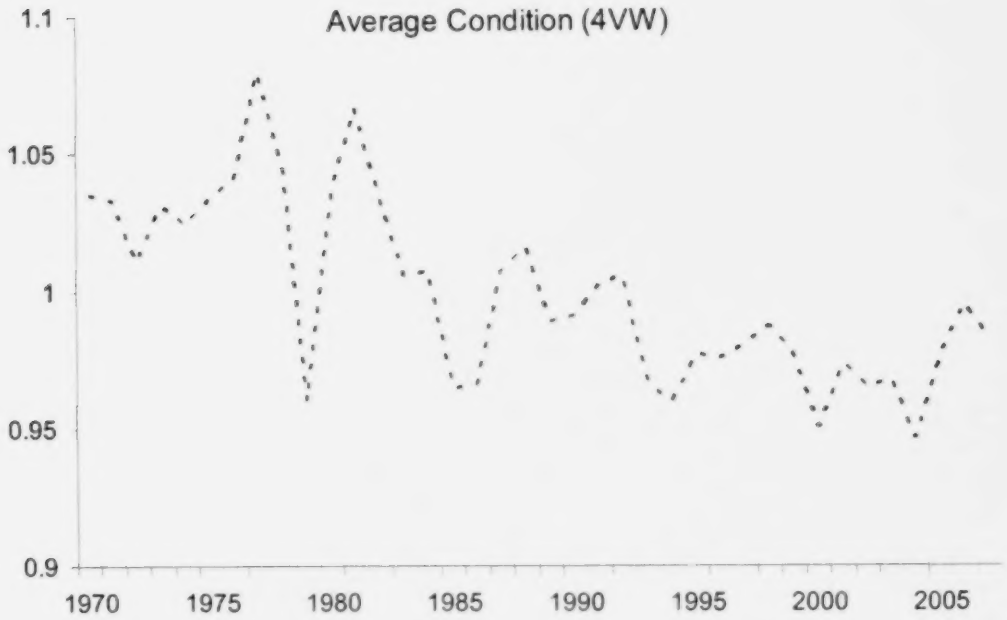

Figure 3a. Average condition (Fulton's K) in NAFO Div. 4VW from the Scotia-Fundy summer RV survey.

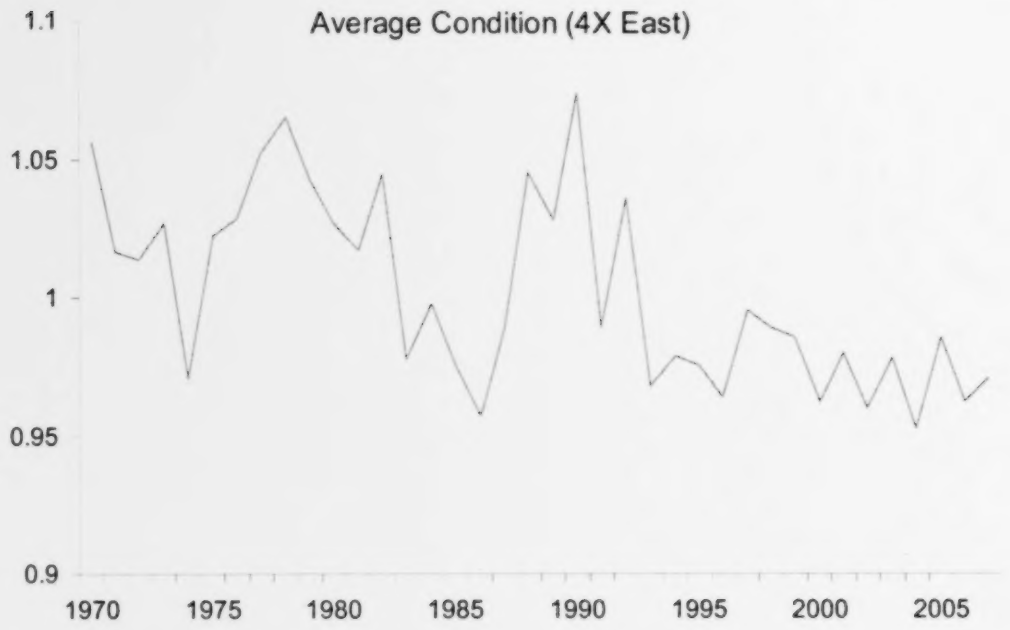

Figure 3b. Average condition (Fulton's K) in NAFO Div. 4X (Scotian Shelf) from the Scotia-Fundy summer RV survey.

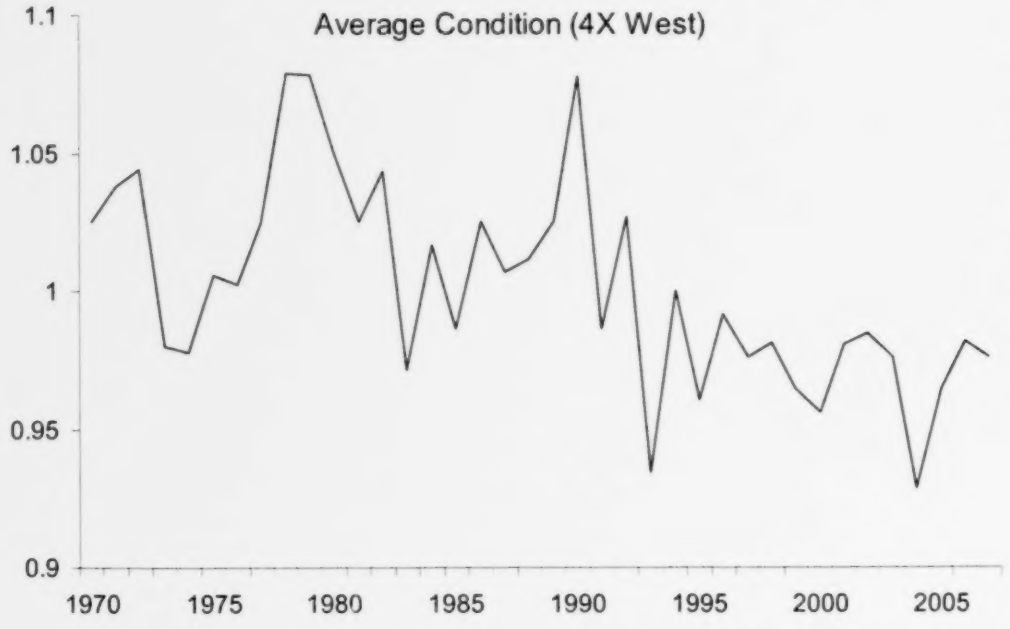

Figure 3c. Average condition (Fulton's K) in NAFO Div. 4X (Bay of Fundy) from the Scotia-Fundy summer RV survey.

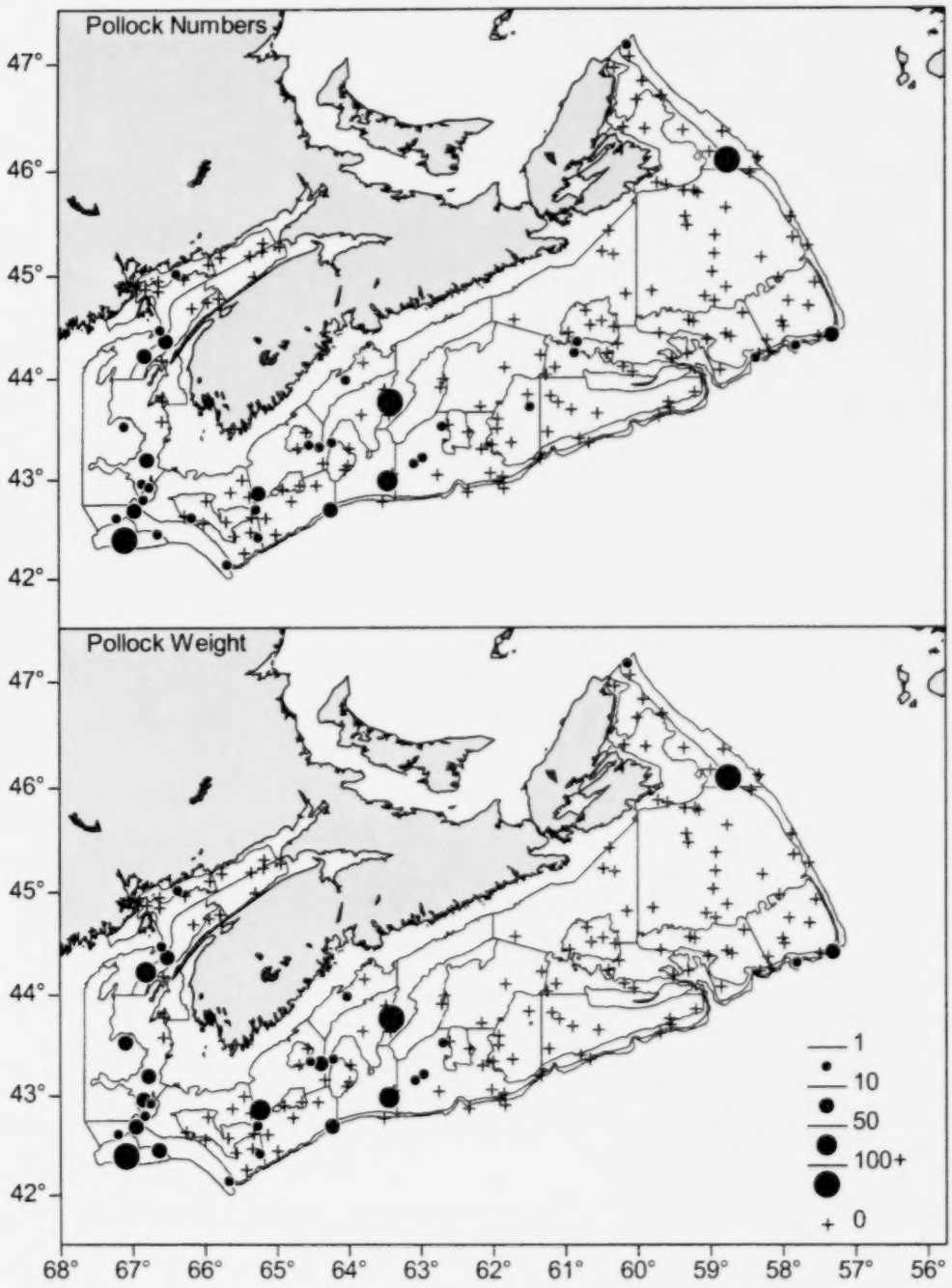

Figure 4a. Distribution of pollock catches during the 2007 Scotia-Fundy summer RV survey.

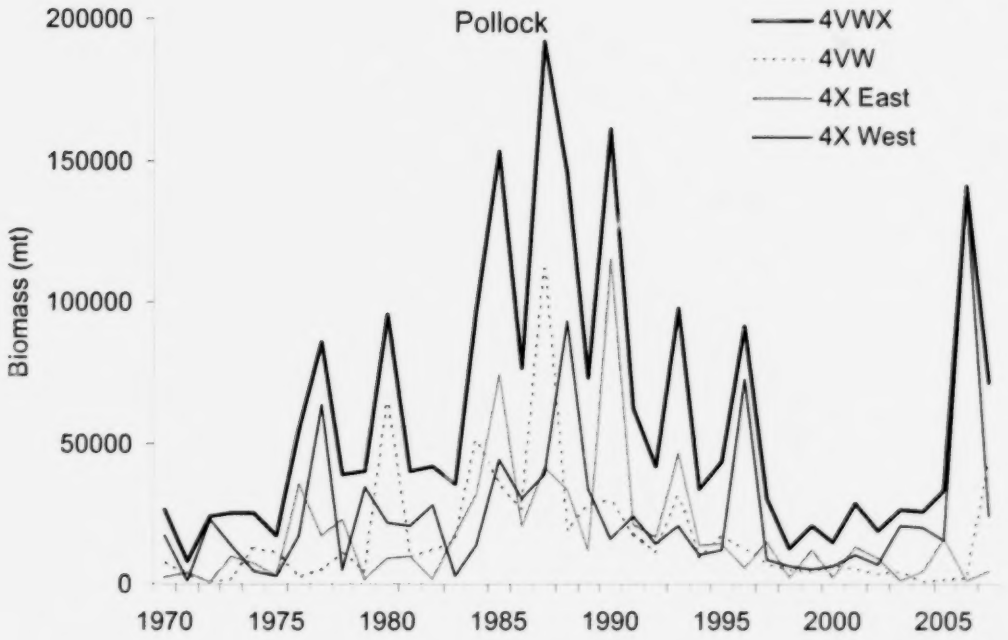

Figure 4b. Biomass estimate for pollock from the Scotia-Fundy summer RV survey.

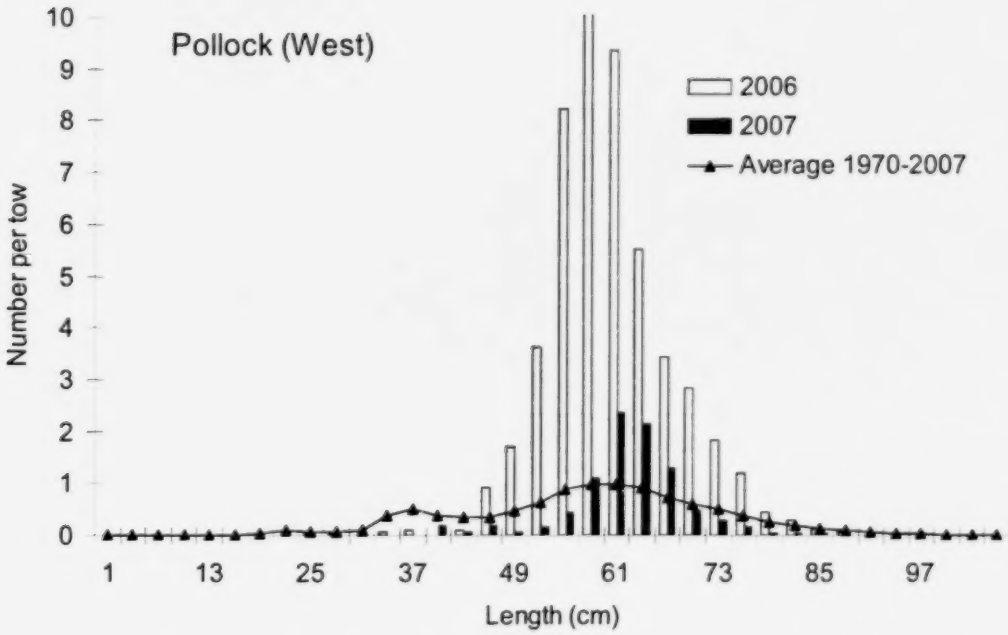

Figure 4c. Length composition for pollock western component from the Scotia-Fundy summer RV survey.

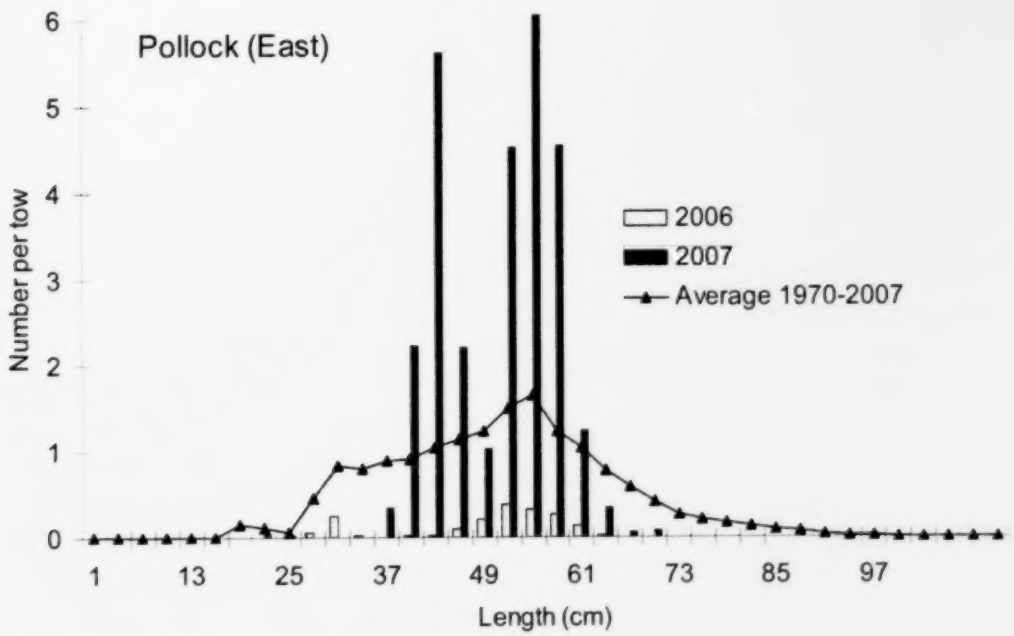

Figure 4d. Length composition for pollock eastern component from the Scotia-Fundy summer RV survey.

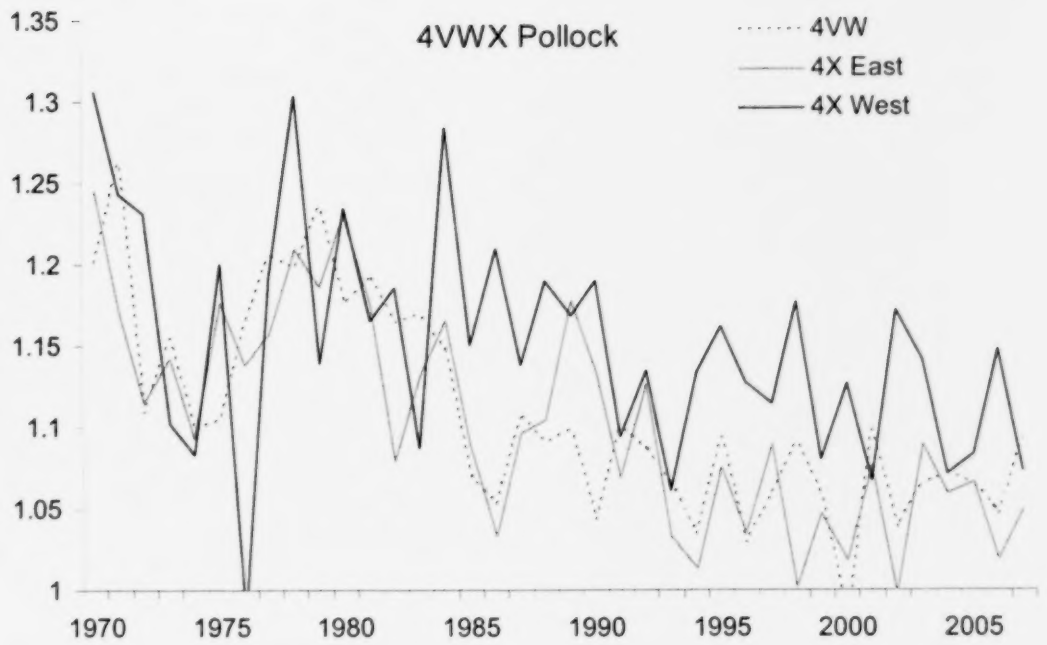

Figure 4e. Condition factor (Fulton's K) for pollock from the Scotia-Fundy summer RV survey.

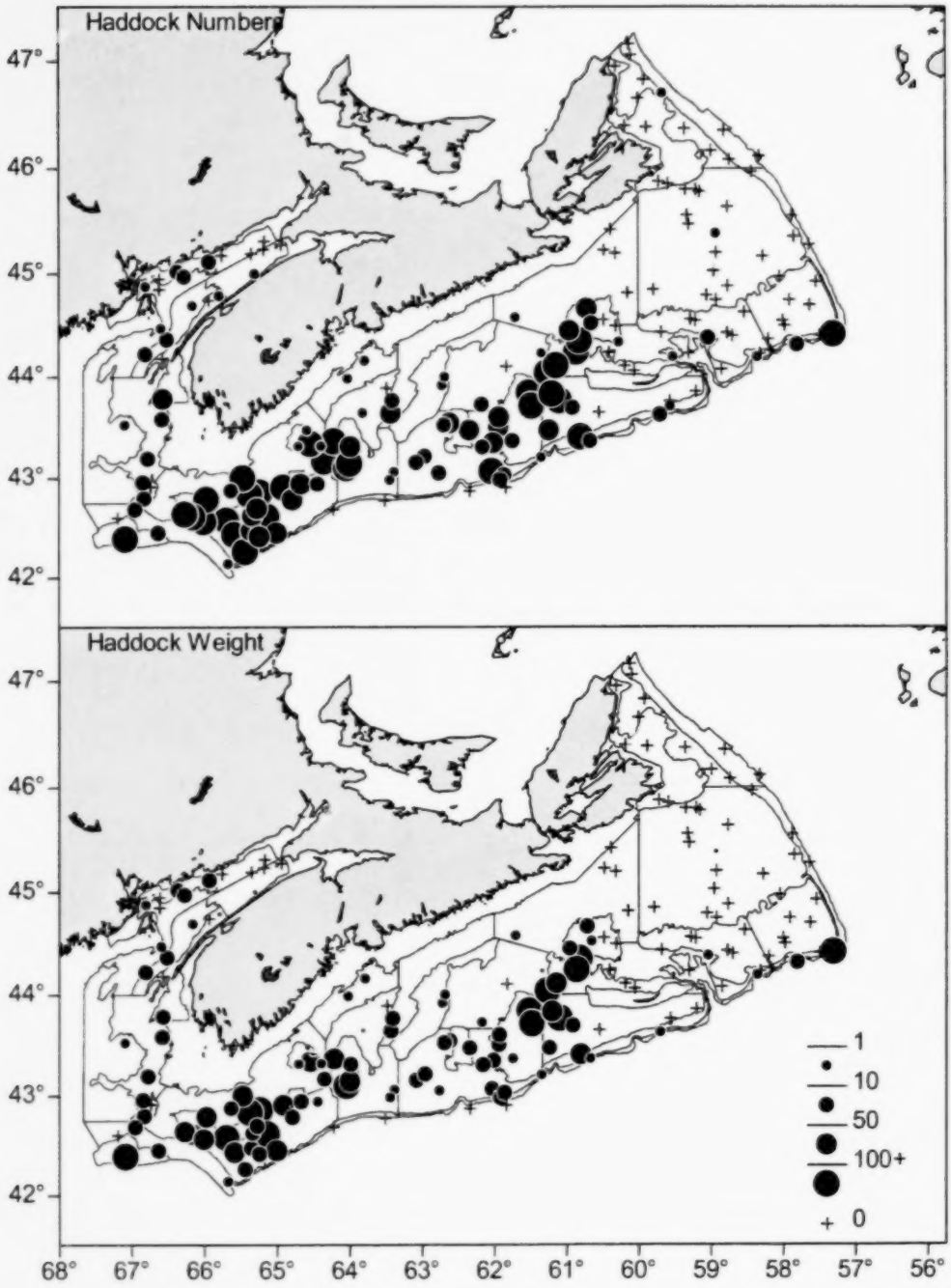

Figure 5a. Distribution of haddock catches during the 2007 Scotia-Fundy summer RV survey.

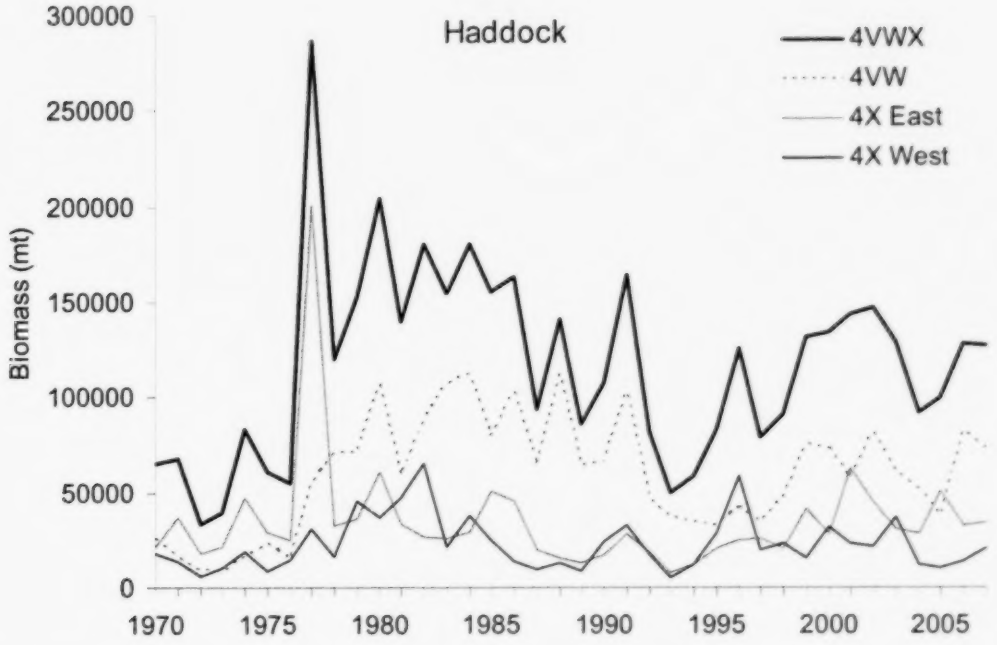

Figure 5b. Biomass estimate for haddock from the Scotia-Fundy summer RV survey.

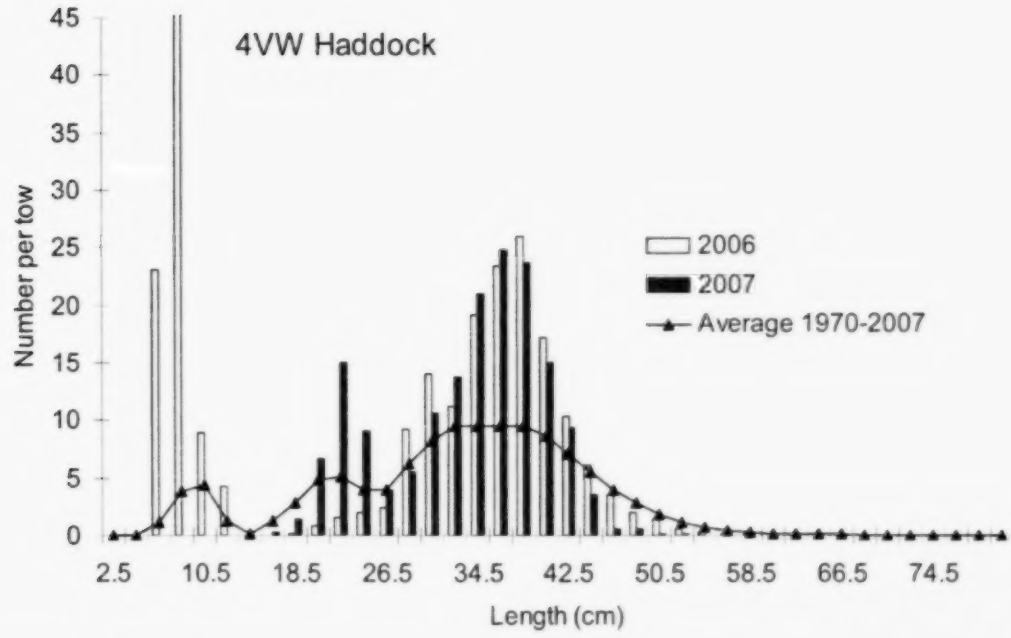

Figure 5c. Length composition for haddock in 4VW from the Scotia-Fundy summer RV survey.

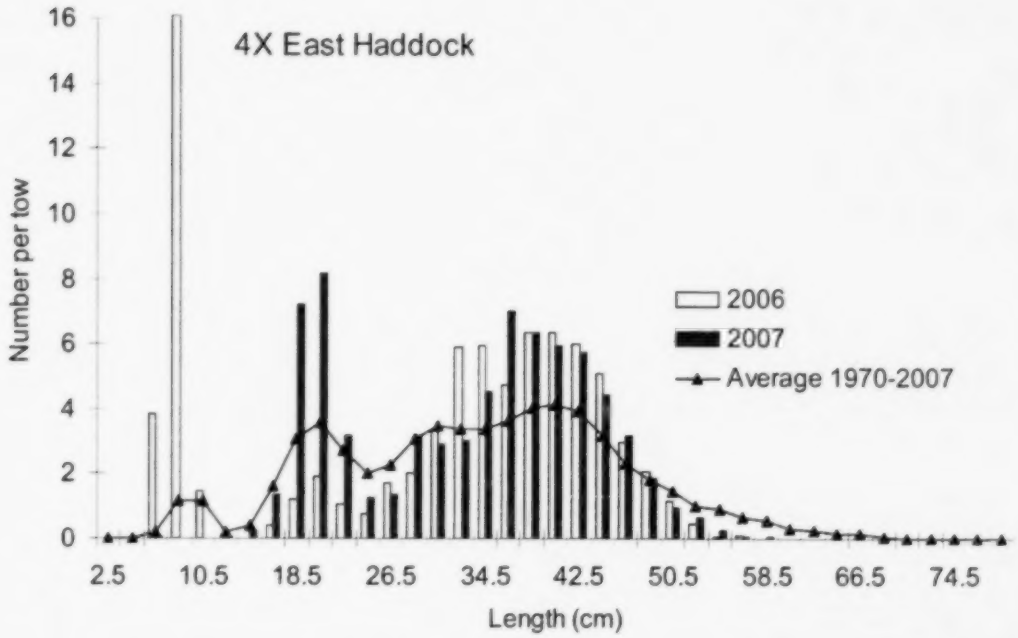

Figure 5d. Length composition for haddock in 4X East from the Scotia-Fundy summer RV survey.

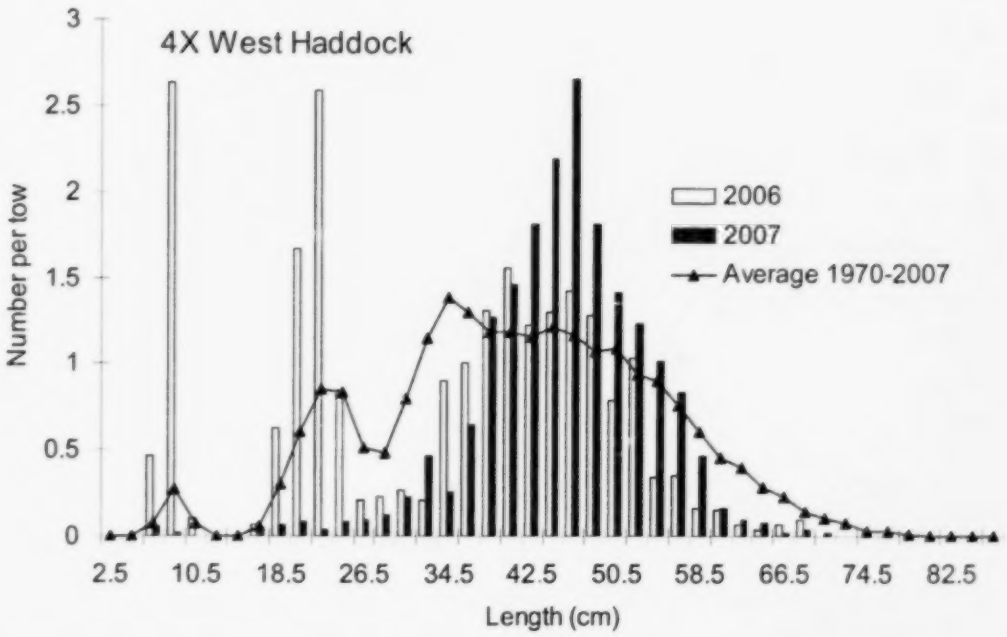

Figure 5e. Length composition for haddock in 4X West from the Scotia-Fundy summer RV survey.

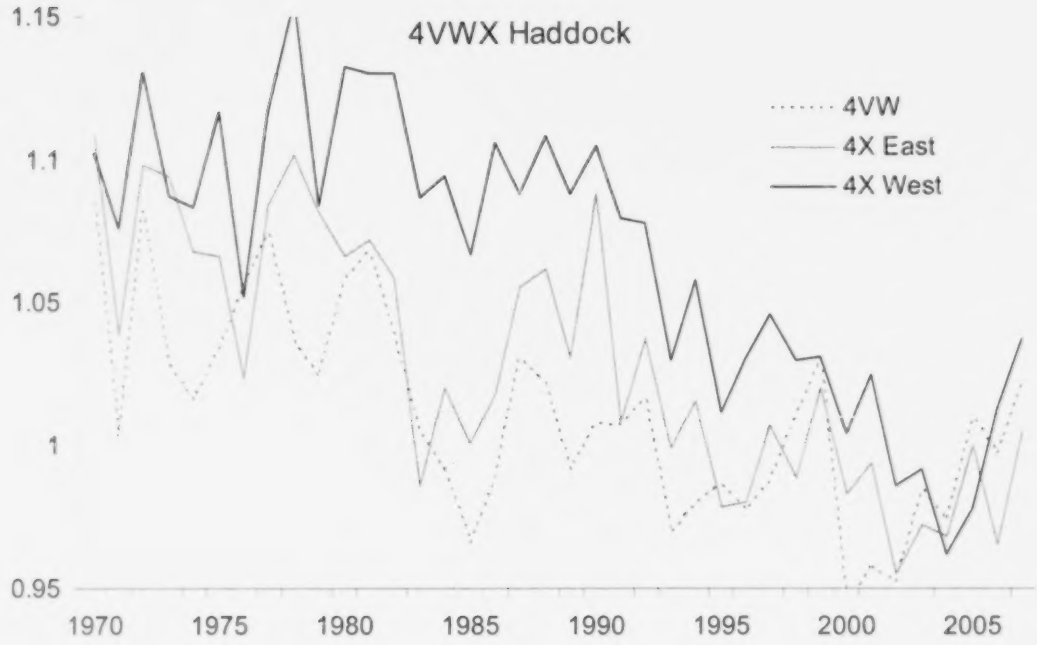

Figure 5f. Condition factor (Fulton's K) for haddock from the Scotia-Fundy summer RV survey.

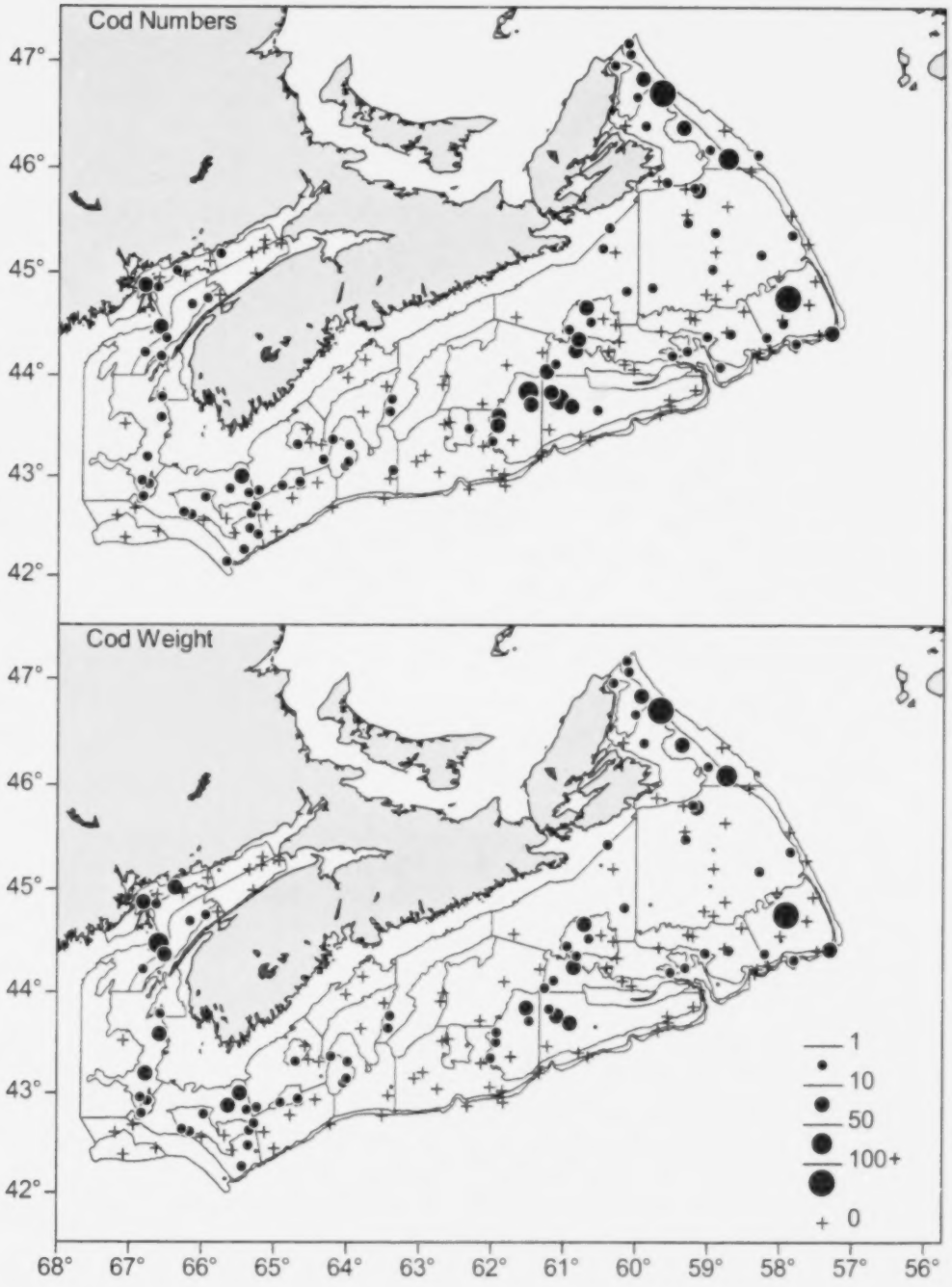

Figure 6a. Distribution of cod catches during the 2007 Scotia-Fundy summer RV survey.

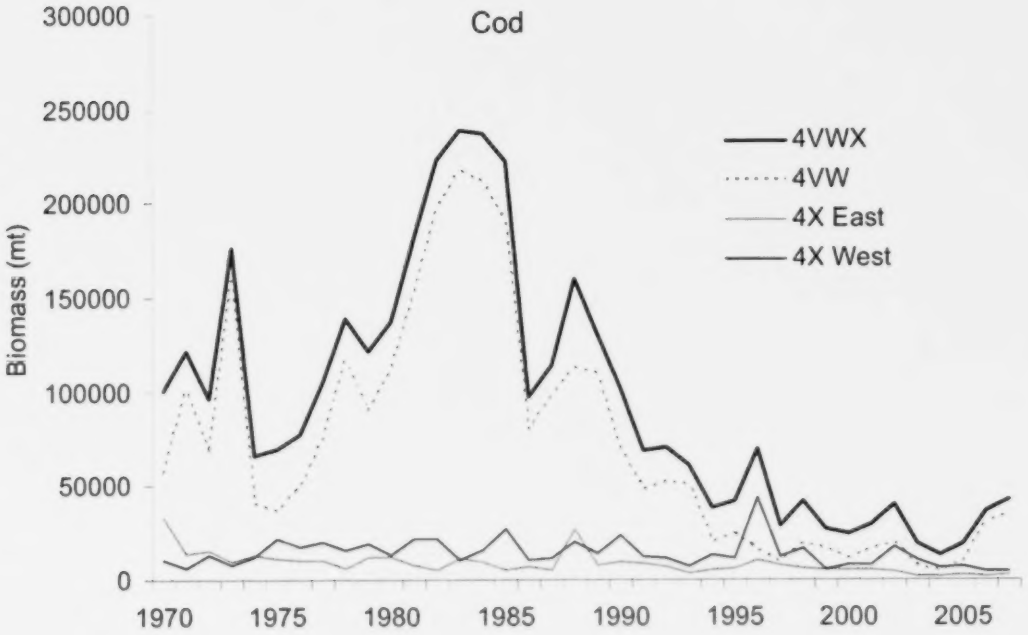

Figure 6b. Biomass estimate for cod from the Scotia-Fundy summer RV survey.

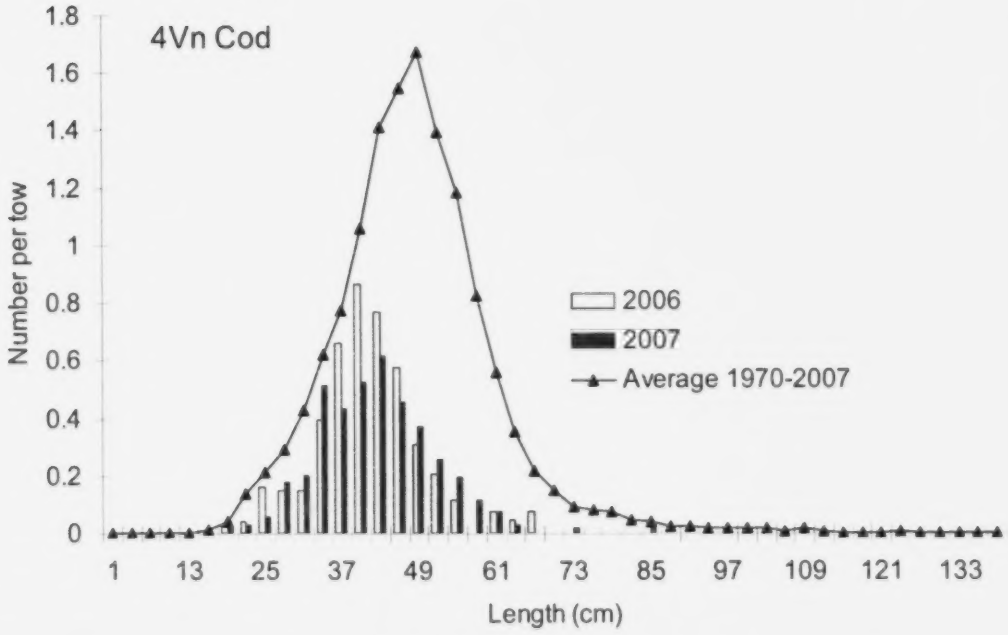

Figure 6c. Length composition for cod in 4Vn from the Scotia-Fundy summer RV survey.

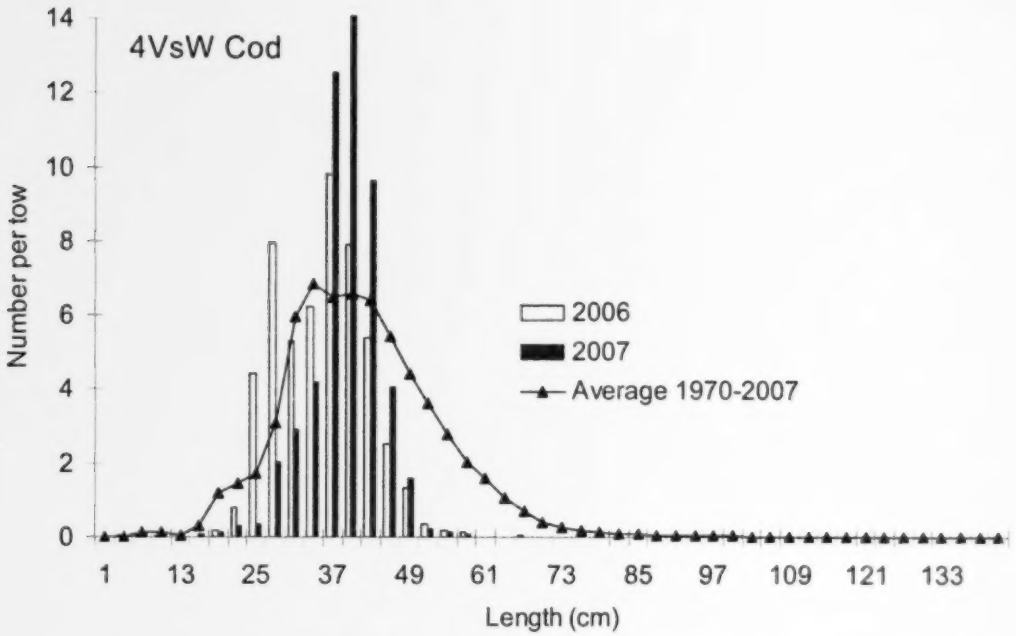

Figure 6d. Length composition for cod in 4VsW from the Scotia-Fundy summer RV survey.

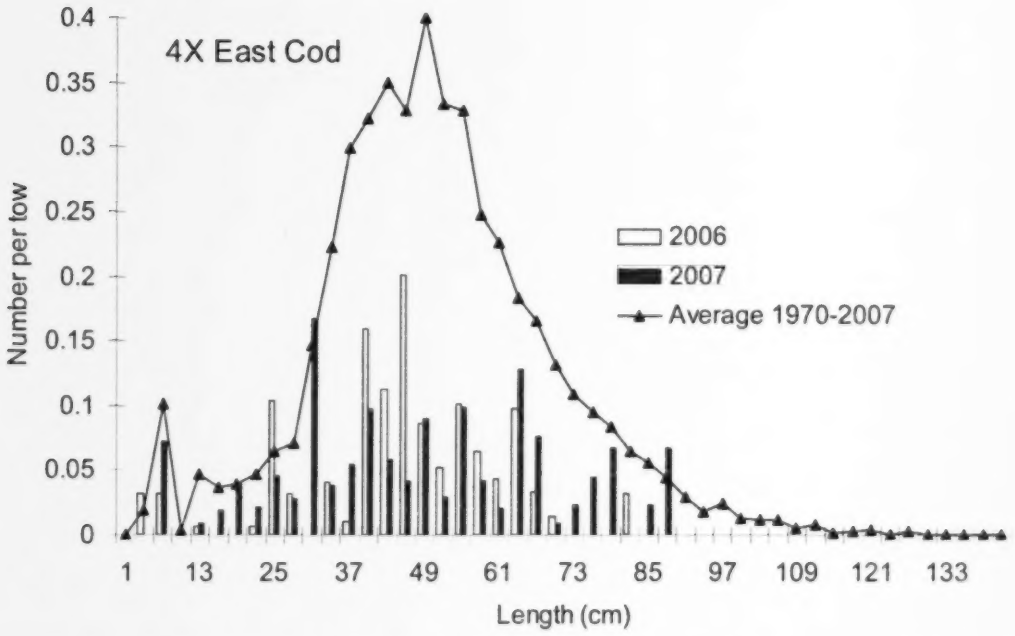

Figure 6e. Length composition for cod in 4X East from the Scotia-Fundy summer RV survey.

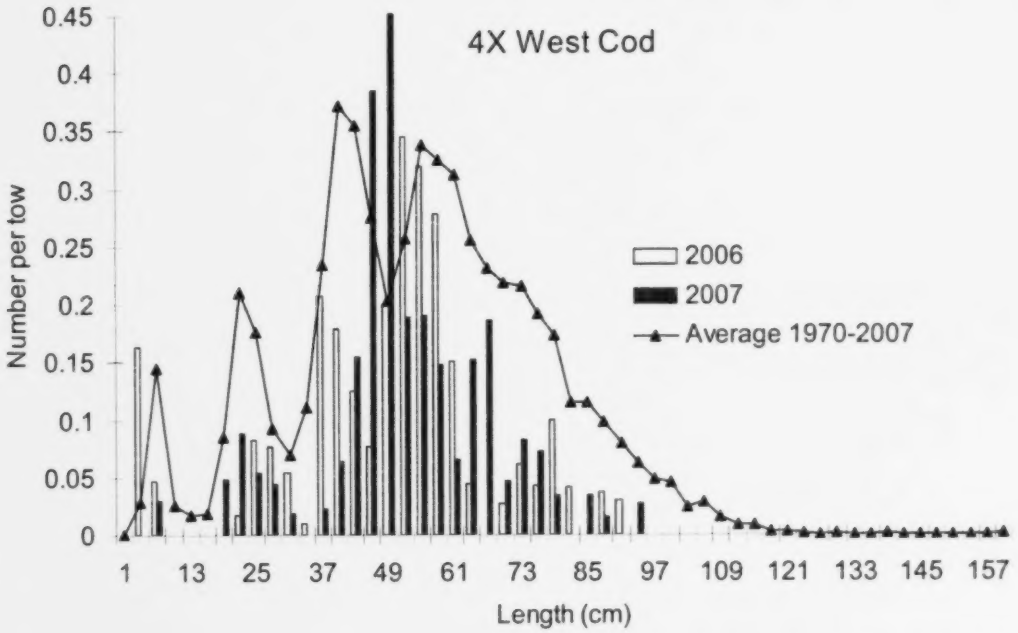

Figure 6f. Length composition for cod in 4X West from the Scotia-Fundy summer RV survey.

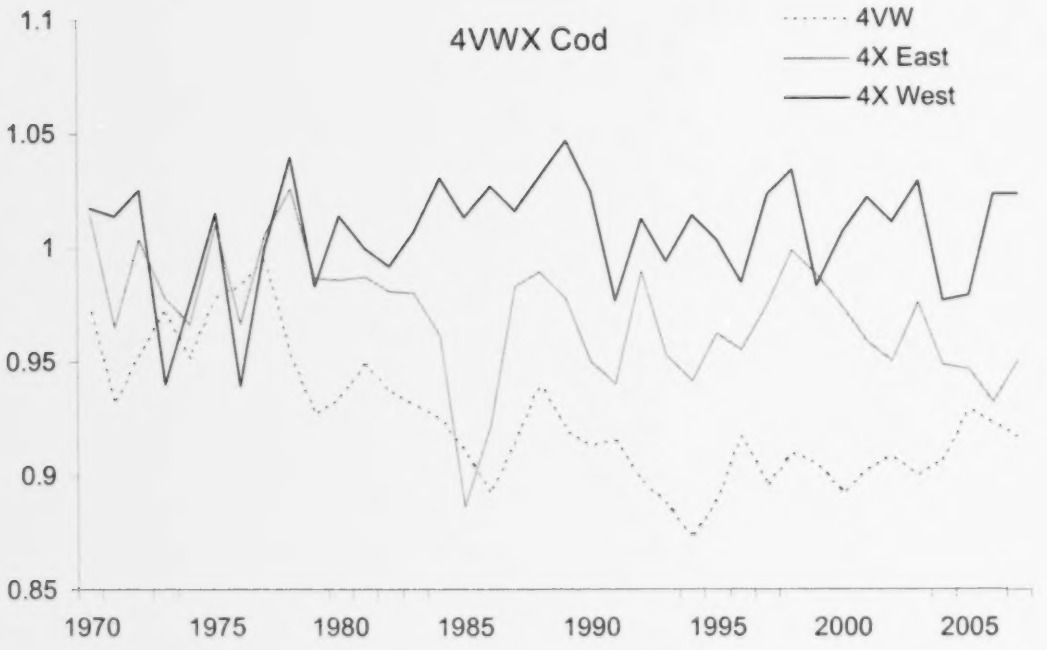

Figure 6g. Condition factor (Fulton's K) for cod from the Scotia-Fundy summer RV survey.

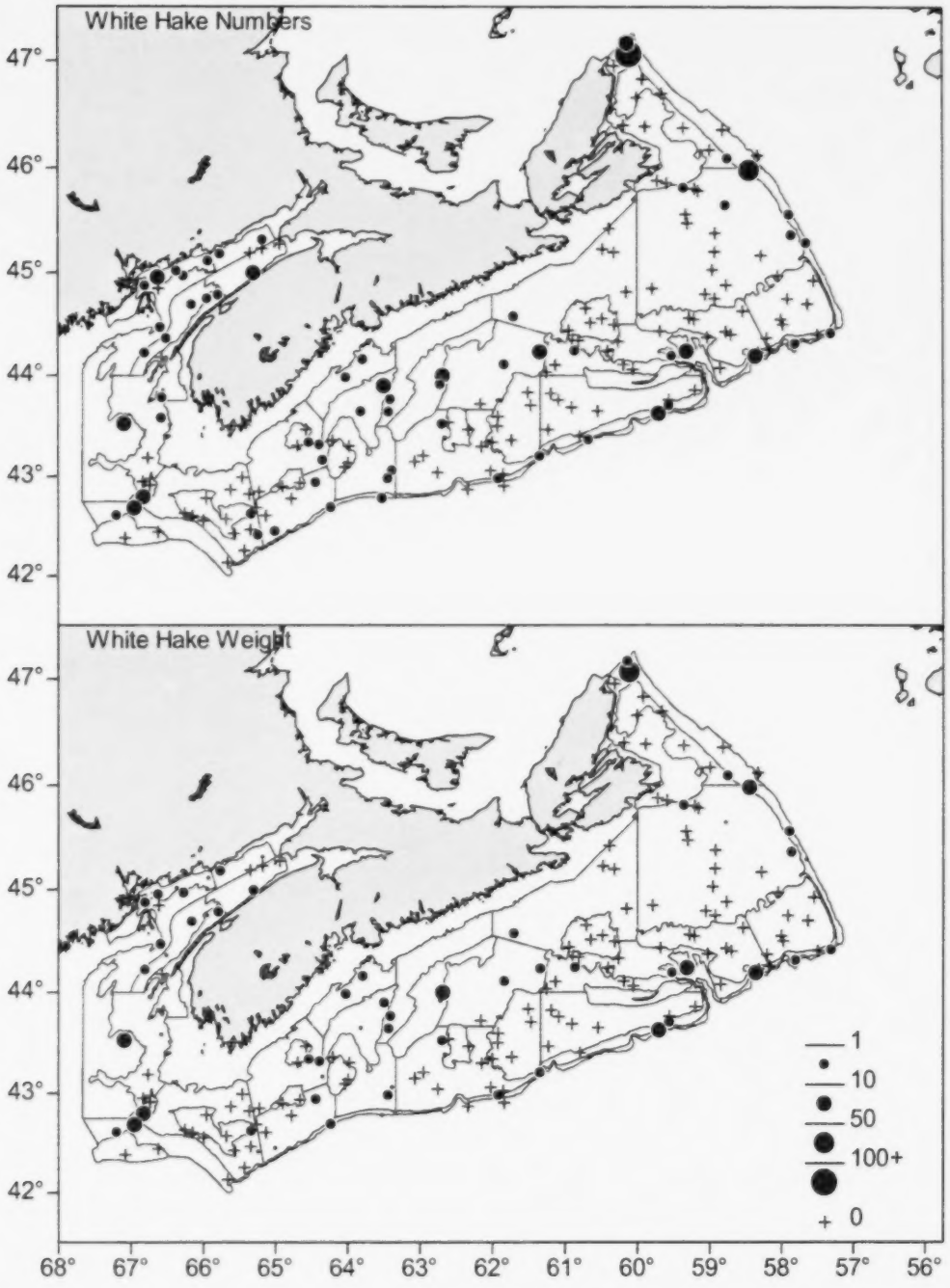

Figure 7a. Distribution of white hake catches during the 2007 Scotia-Fundy summer RV survey.

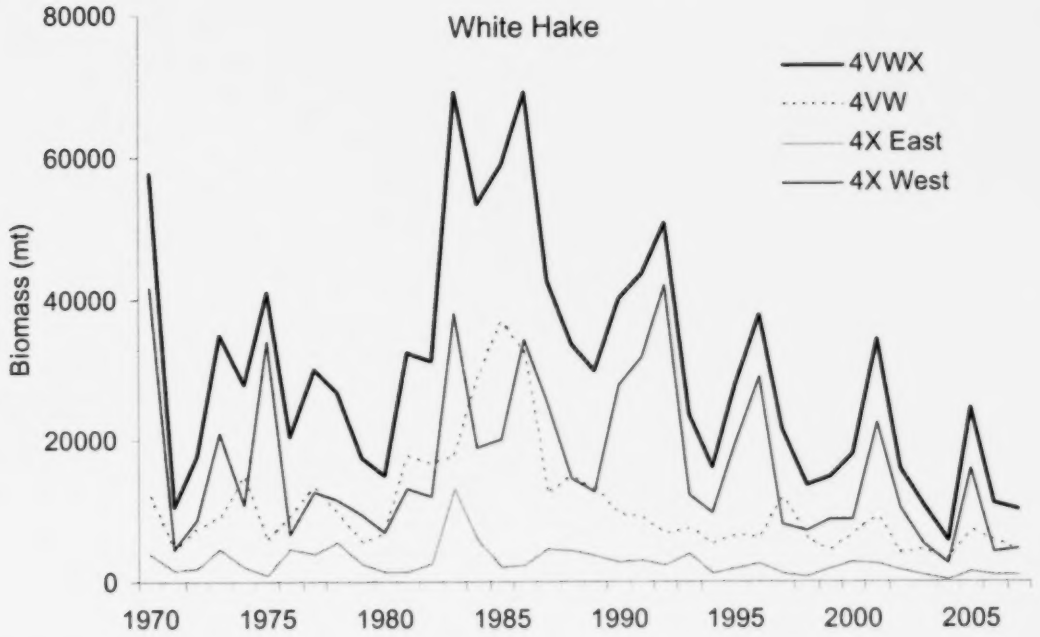

Figure 7b. Biomass estimate for white hake from the Scotia-Fundy summer RV survey.

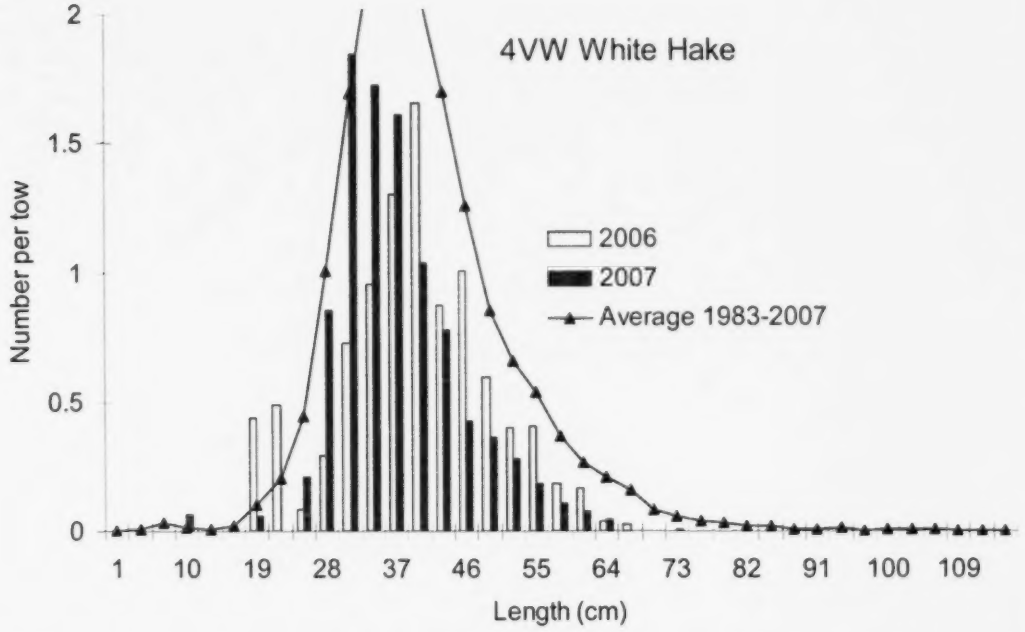

Figure 7c. Length composition for white hake in 4VW from the Scotia-Fundy summer RV survey.

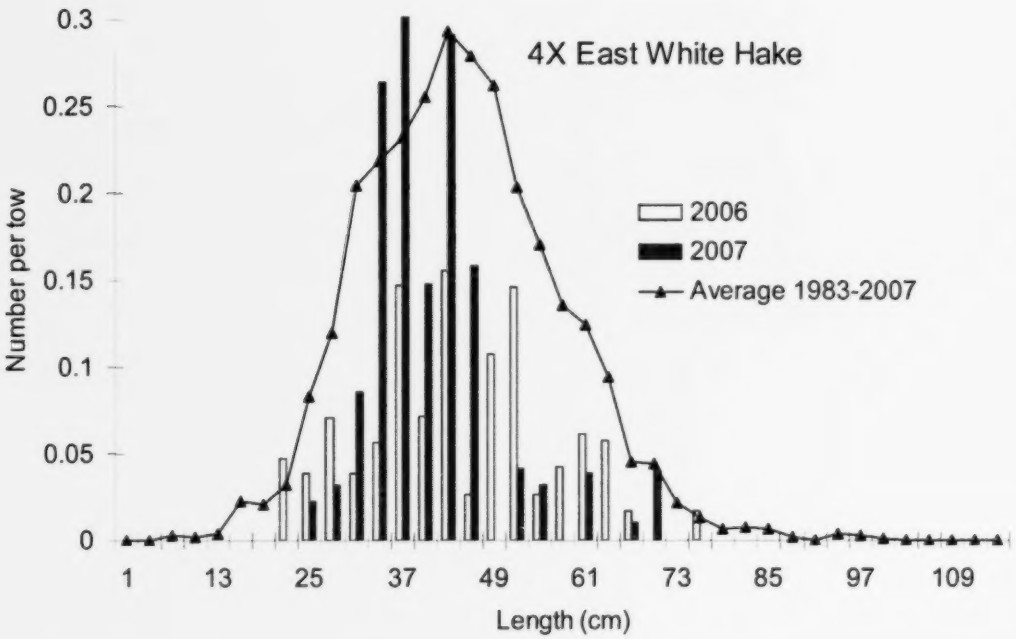

Figure 7d. Length composition for white hake in 4X East from the Scotia-Fundy summer RV survey.

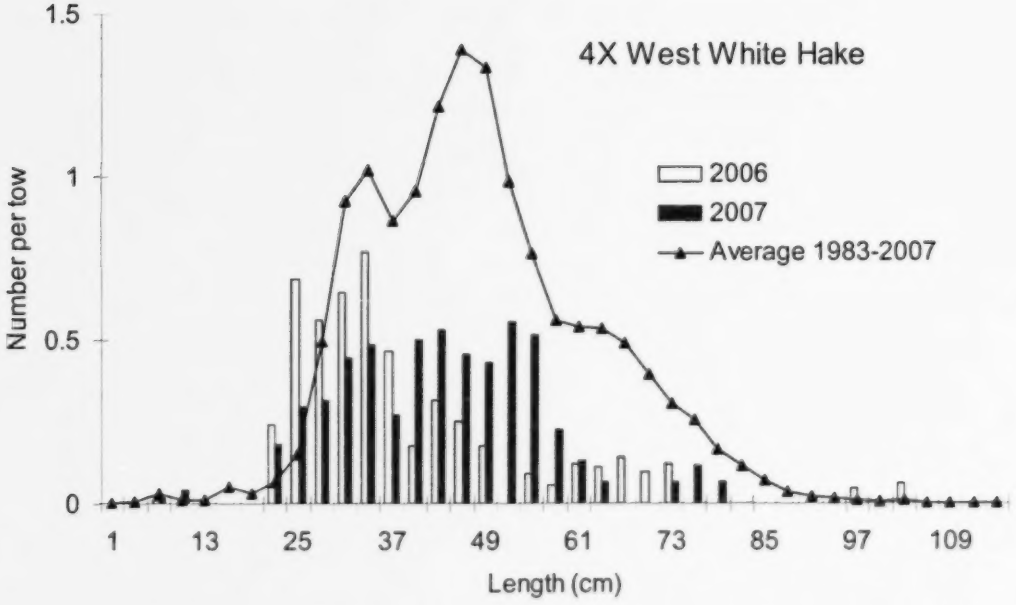

Figure 7e. Length composition for white hake in 4X West from the Scotia-Fundy summer RV survey.

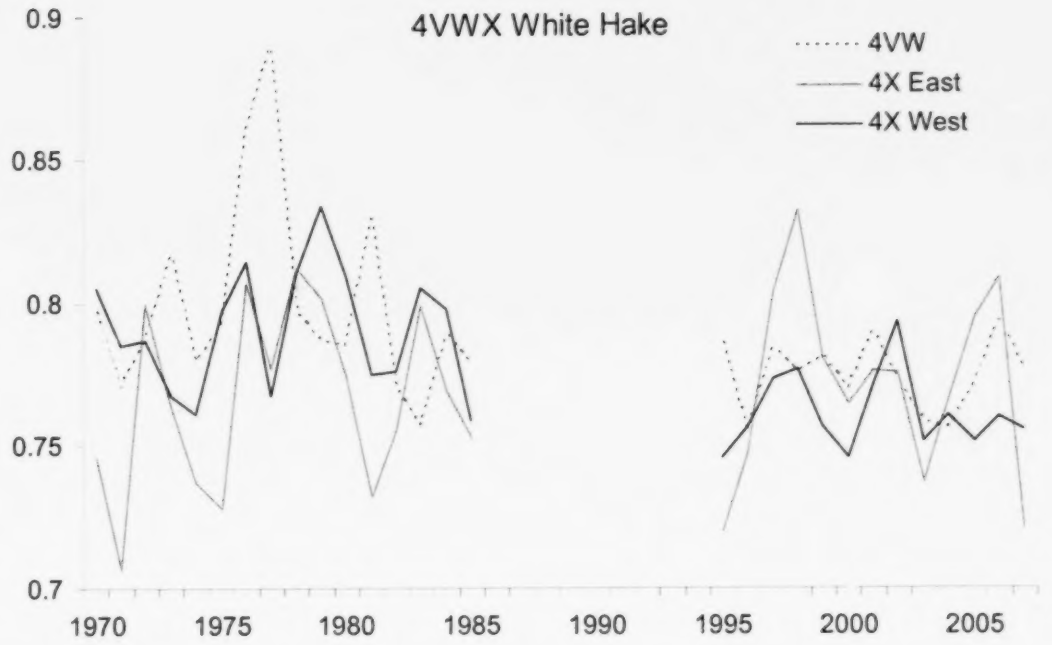

Figure 7f. Condition factor (Fulton's K) for white hake from the Scotia-Fundy summer RV survey.

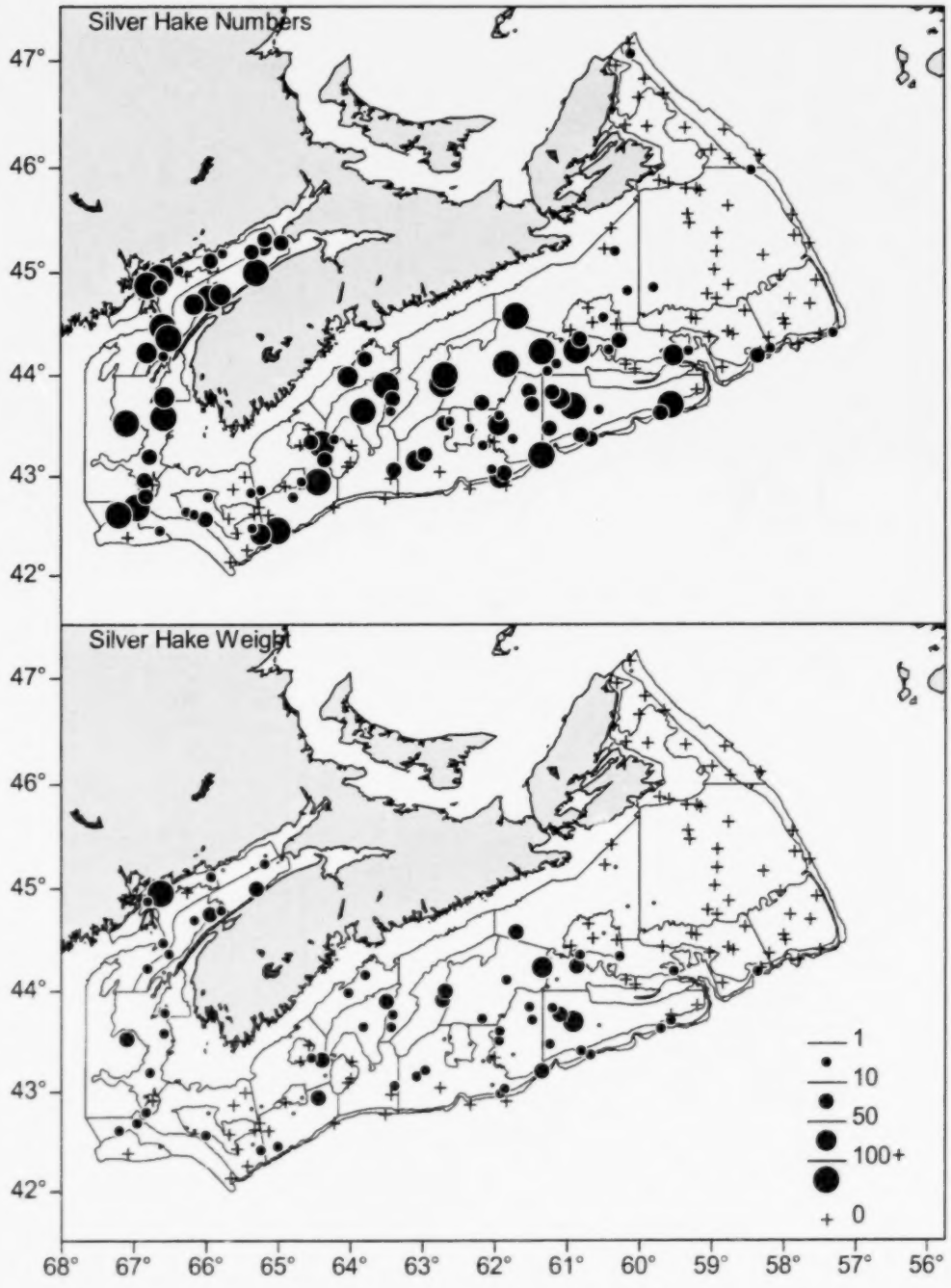

Figure 8a. Distribution of silver hake catches during the 2007 Scotia-Fundy summer RV survey.

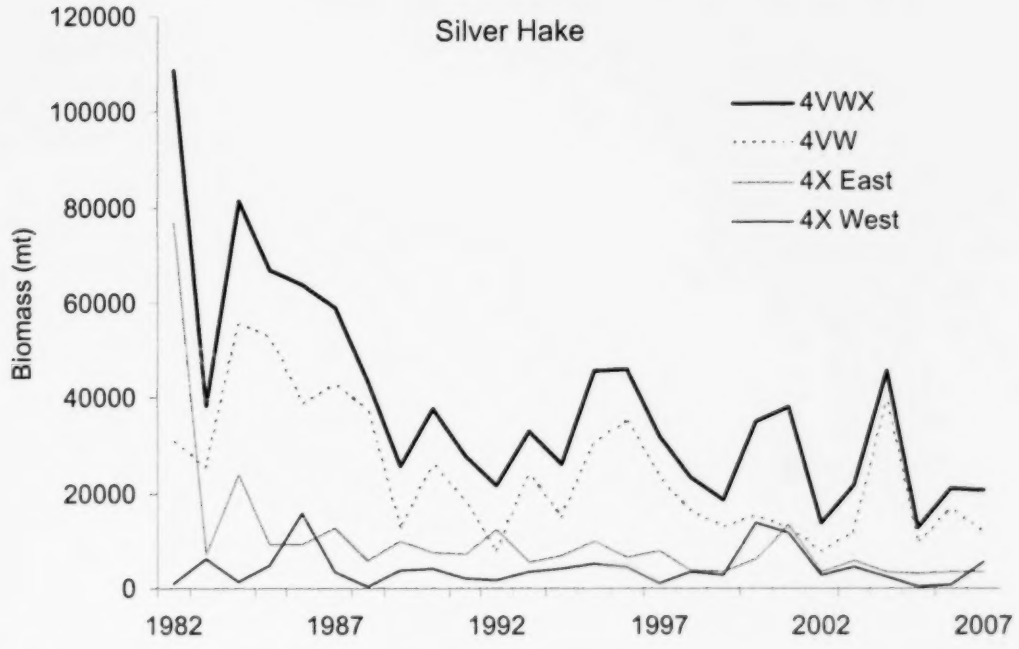

Figure 8b. Biomass estimate for silver hake from the Scotia-Fundy summer RV survey.

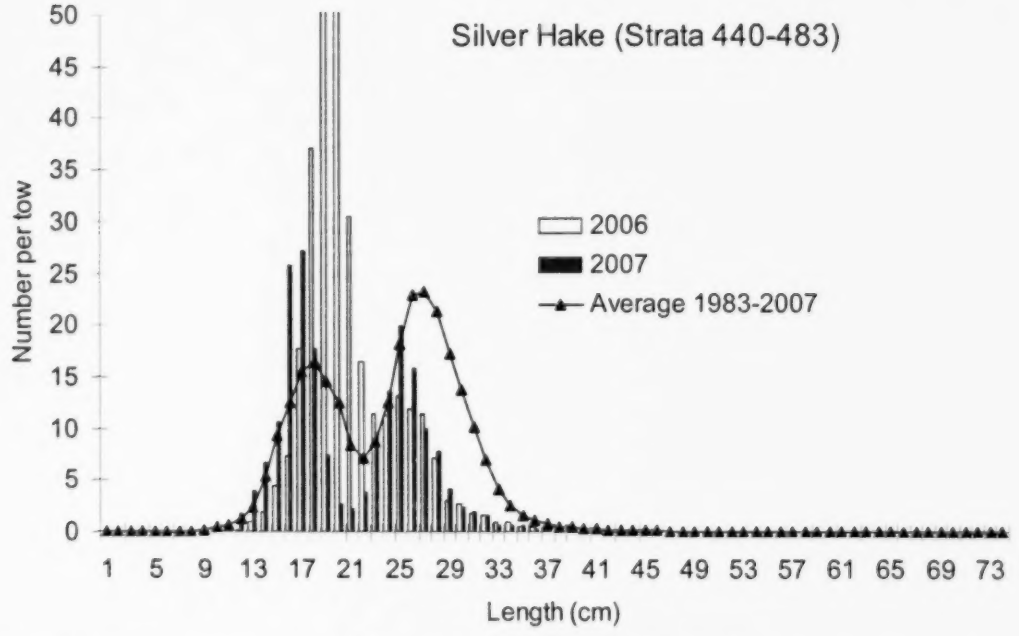

Figure 8c. Length composition for silver hake in Strata 440-483 from the Scotia-Fundy summer RV survey.

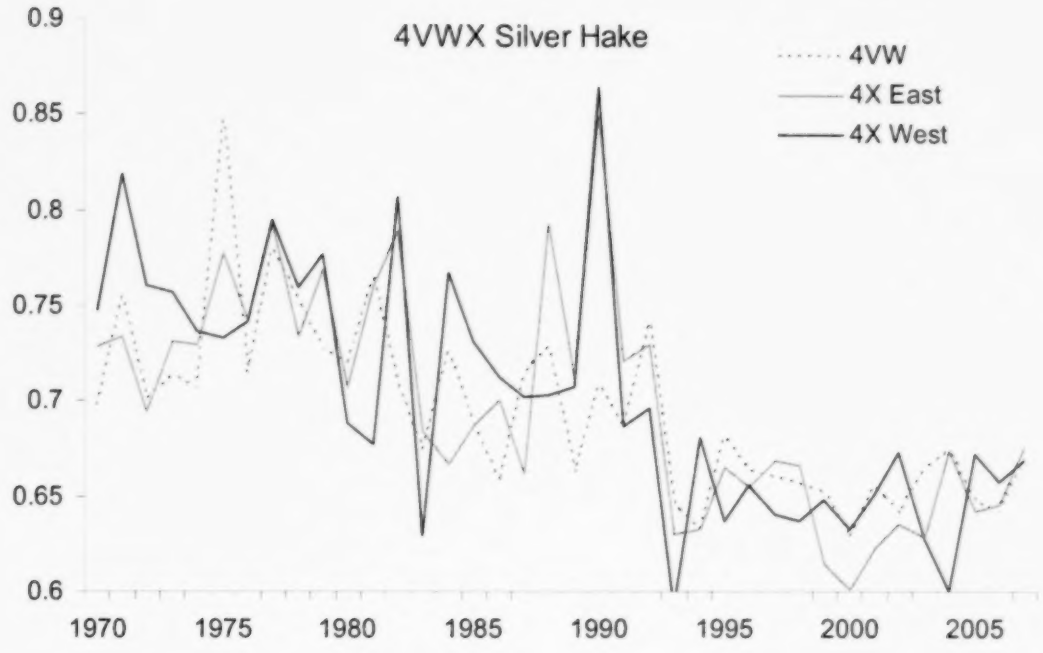

Figure 8d. Condition factor (Fulton's K) for silver hake from the Scotia-Fundy summer RV survey.

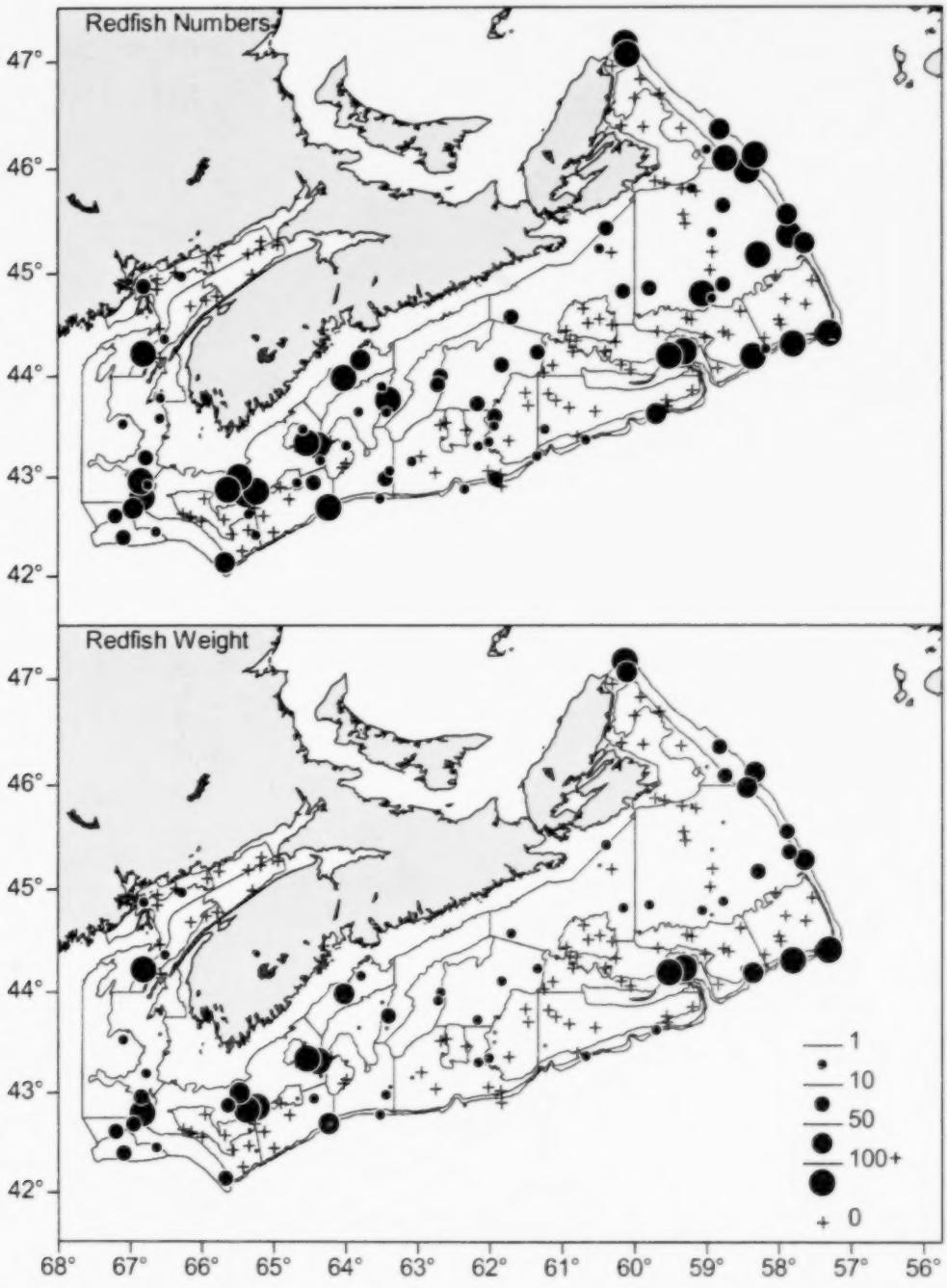

Figure 9a. Distribution of redfish catches during the 2007 Scotia-Fundy summer RV survey.

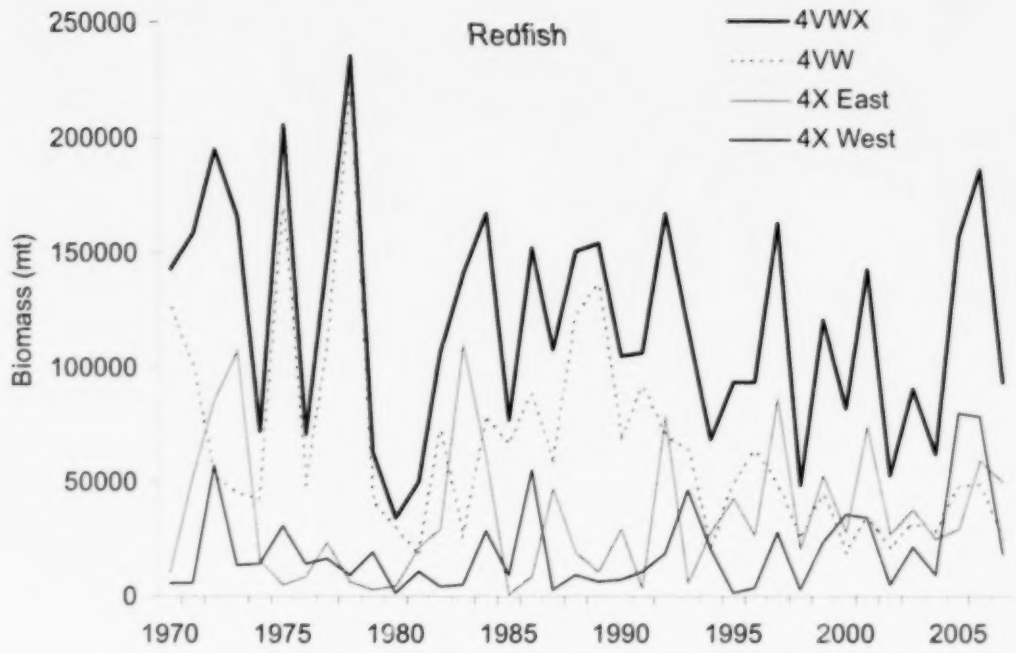

Figure 9b. Biomass estimate for redfish from the Scotia-Fundy summer RV survey.

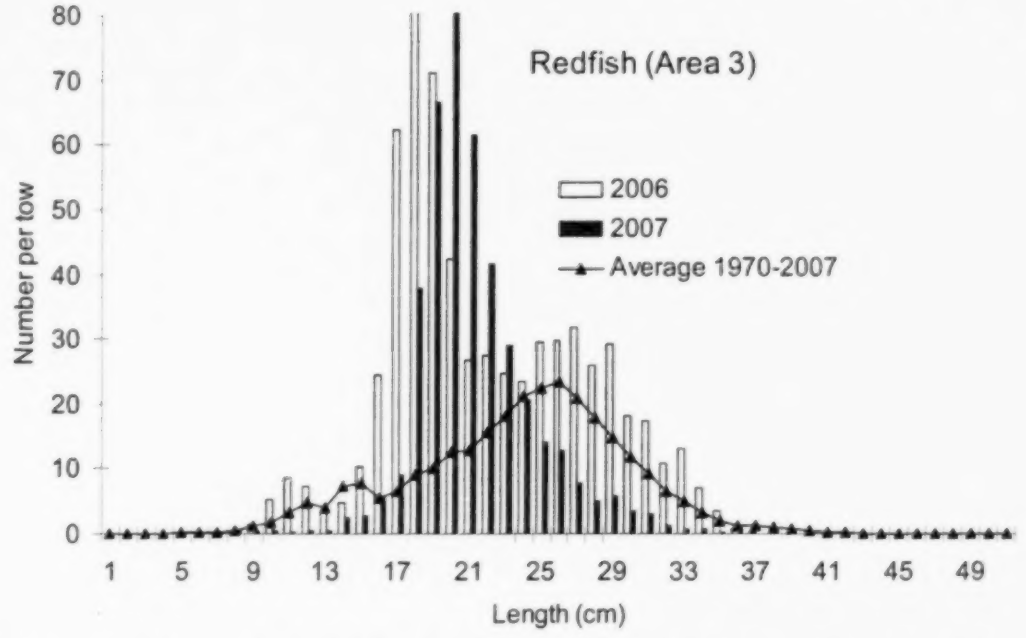

Figure 9c. Length composition for redfish in Area 3 from the Scotia-Fundy summer RV survey.

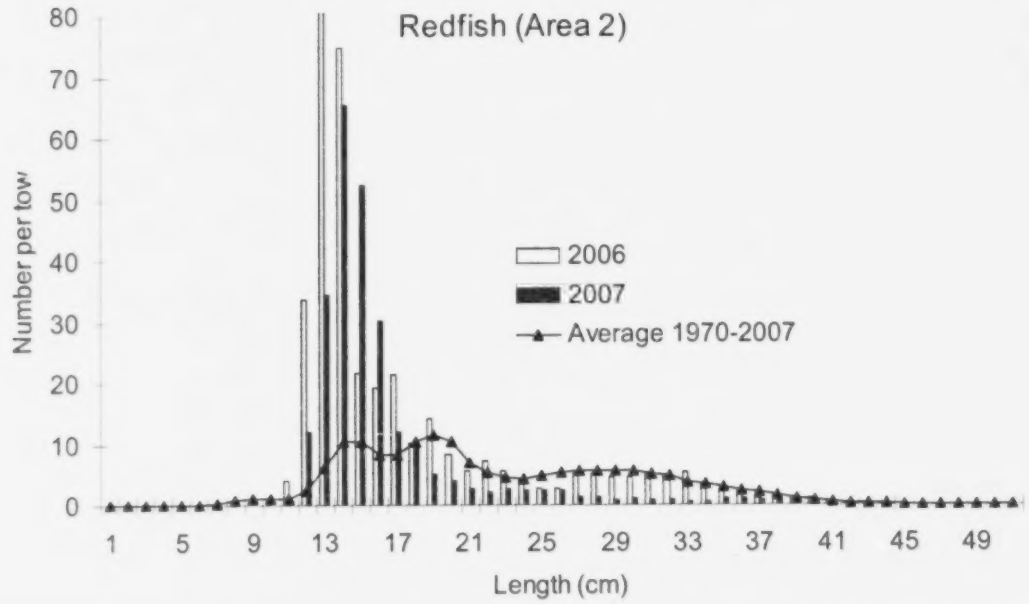

Figure 9d. Length composition for redfish in Area 2 from the Scotia-Fundy summer RV survey.

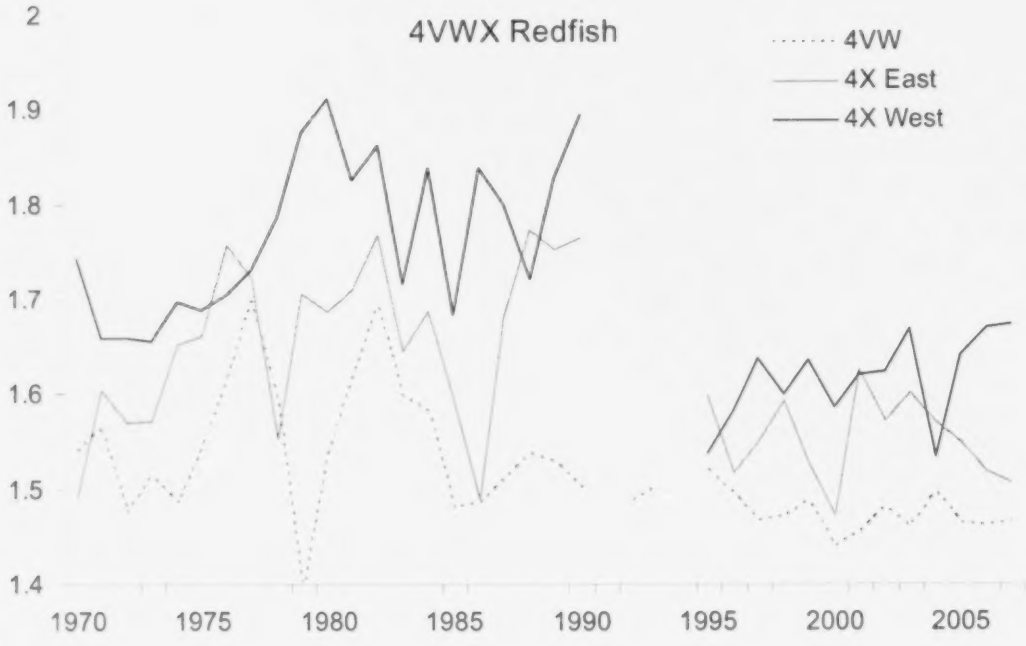

Figure 9e. Condition factor (Fulton's K) for redfish from the Scotia-Fundy summer RV survey.

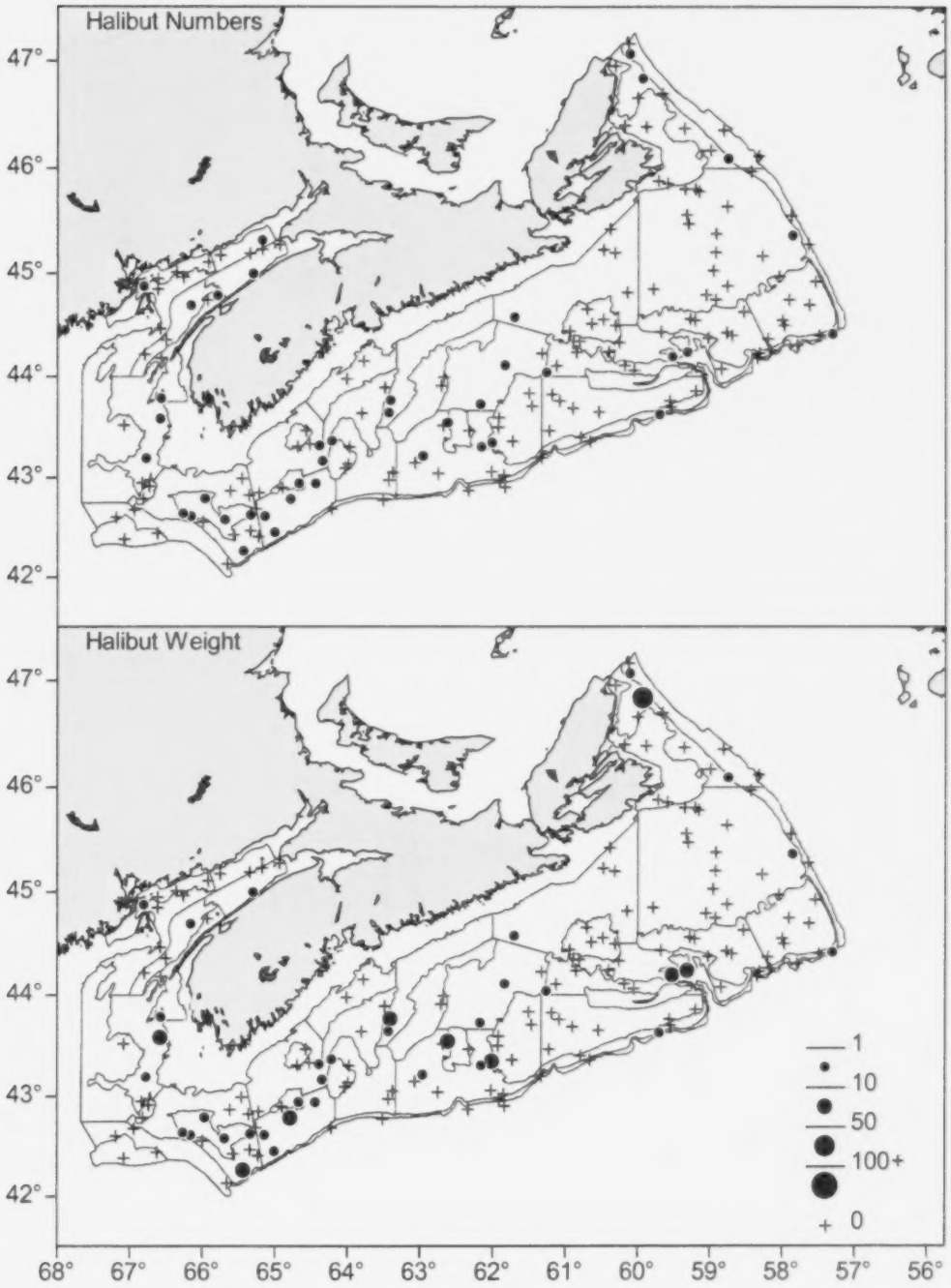

Figure 10a. Distribution of halibut catches during the 2007 Scotia-Fundy summer RV survey.

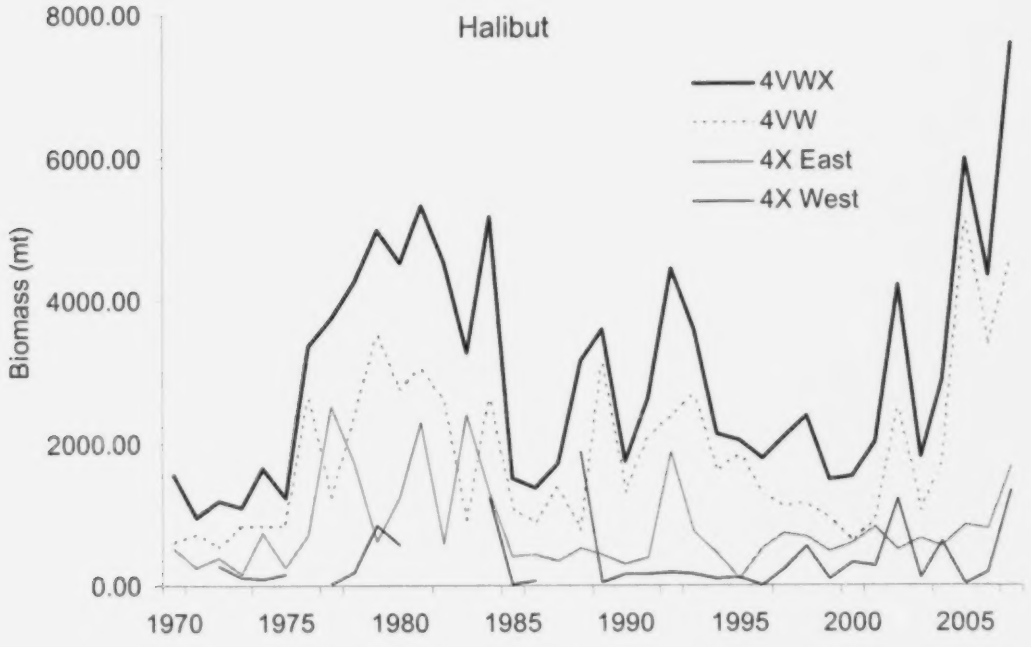

Figure 10b. Biomass estimate for halibut from the Scotia-Fundy summer RV survey.

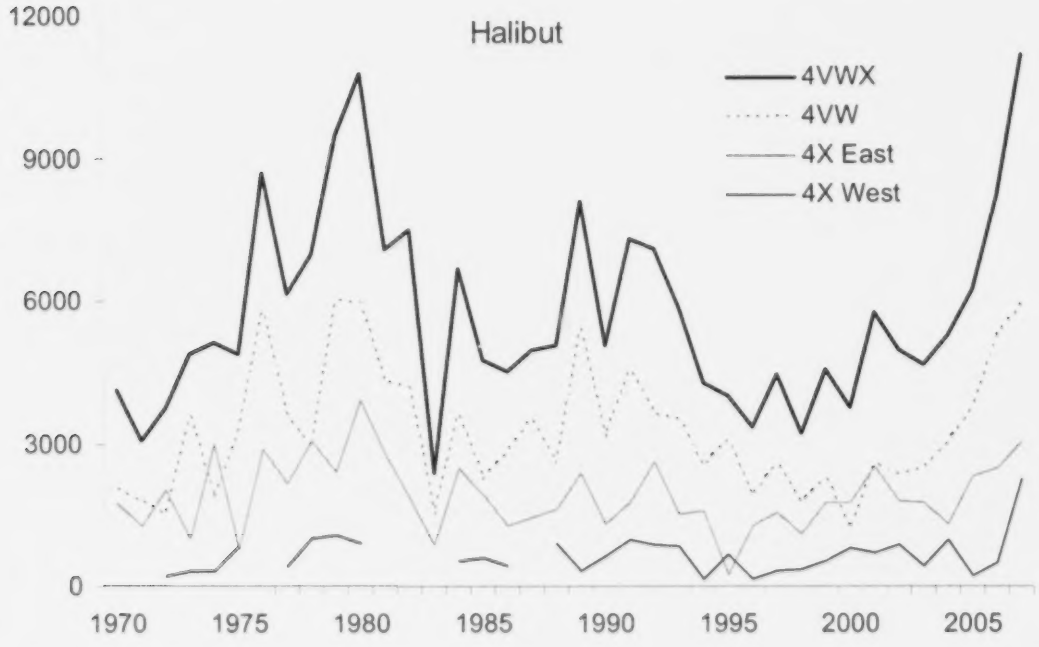

Figure 10c. Stratified area occupied by halibut from the Scotia-Fundy summer RV survey.

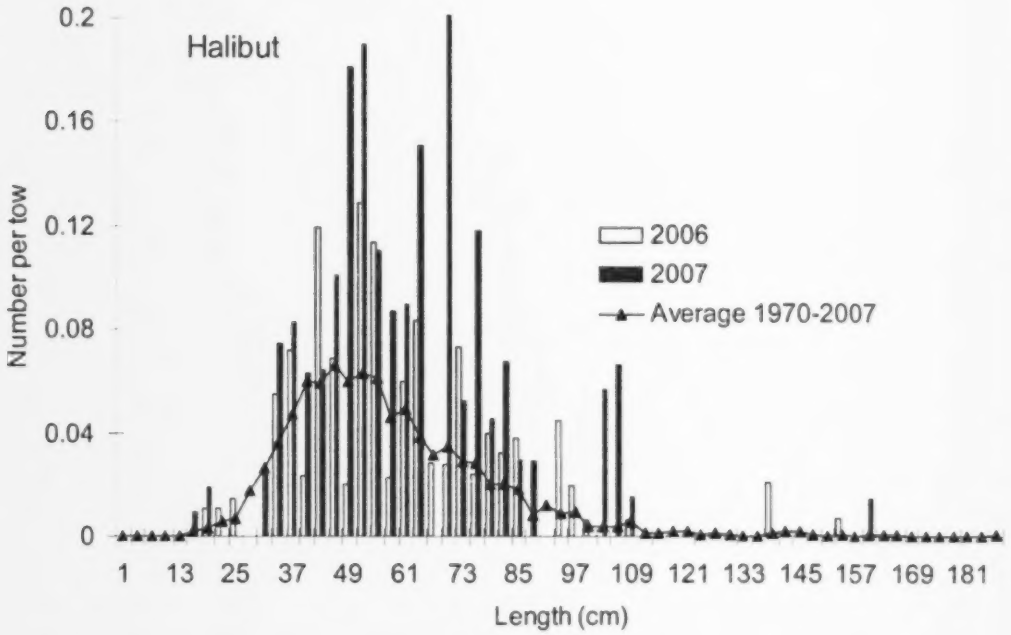

Figure 10d. Length composition for halibut from the Scotia-Fundy summer RV survey.

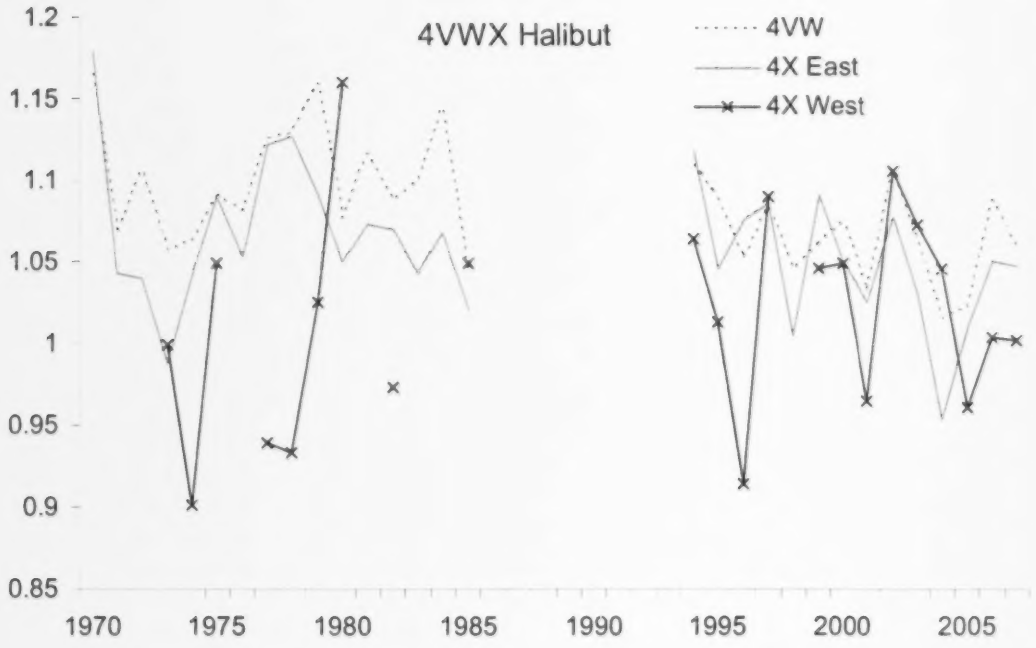

Figure 10e. Condition factor (Fulton's K) for halibut from the Scotia-Fundy summer RV survey.

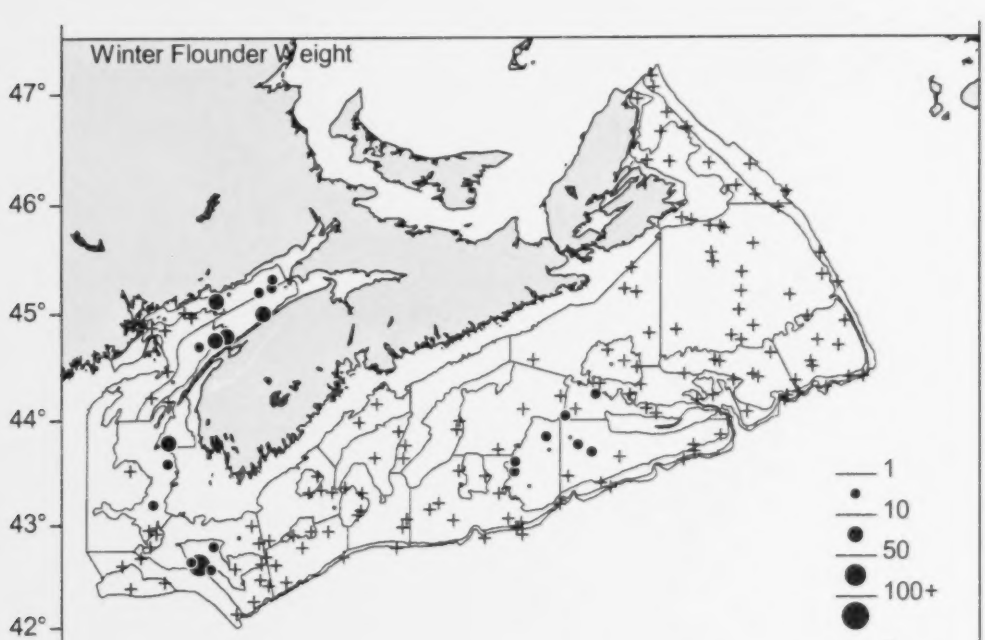

Figure 11a. Distribution of winter flounder catches during the 2007 Scotia-Fundy summer RV survey.

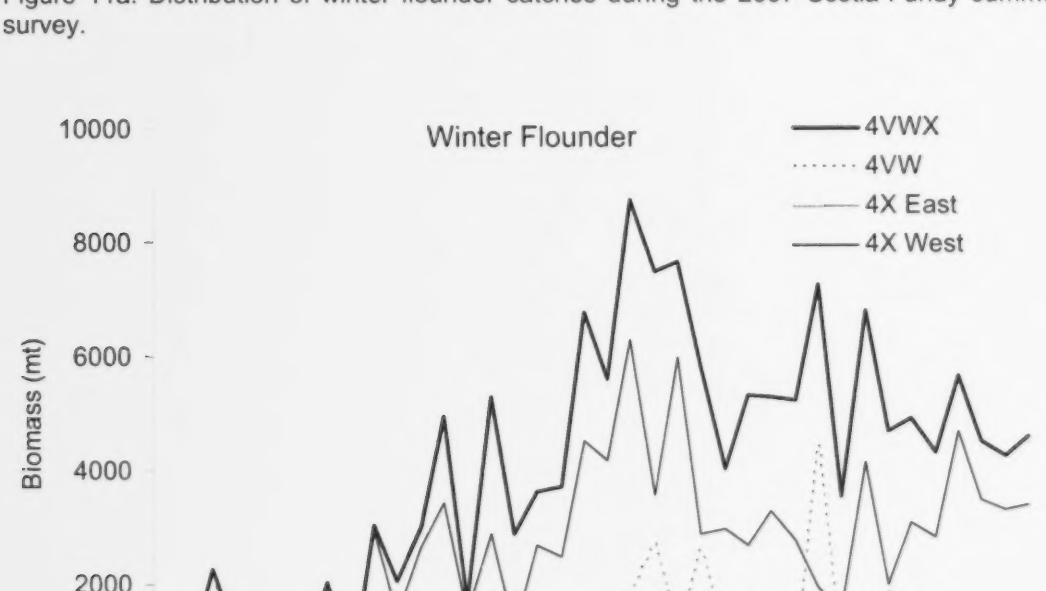

Figure 11b. Biomass estimate for winter flounder from the Scotia-Fundy summer RV survey.

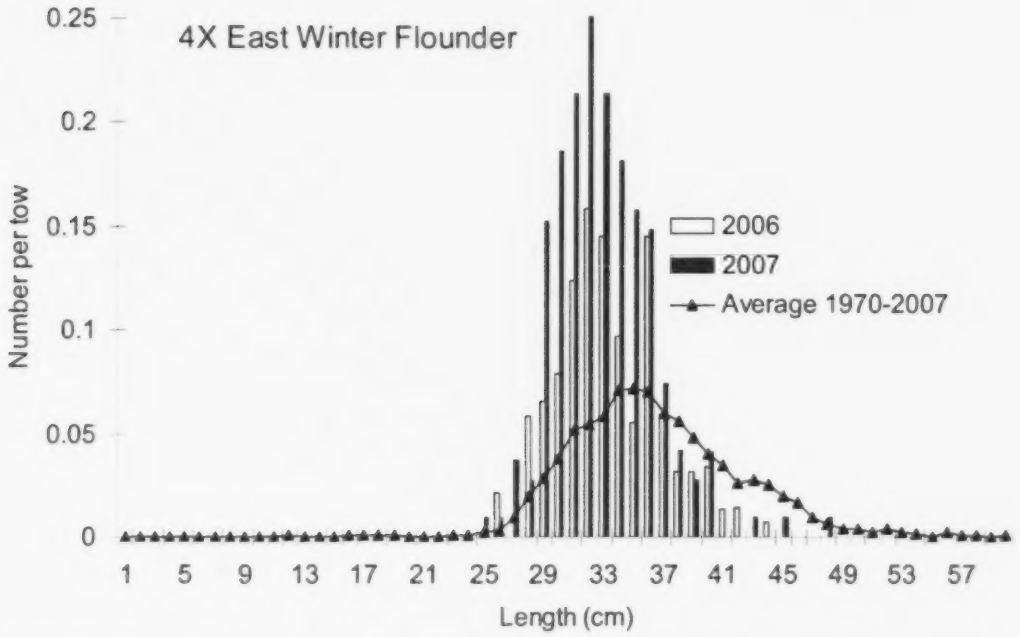

Figure 11c. Length composition for winter flounder in 4X East from the Scotia-Fundy summer RV survey.

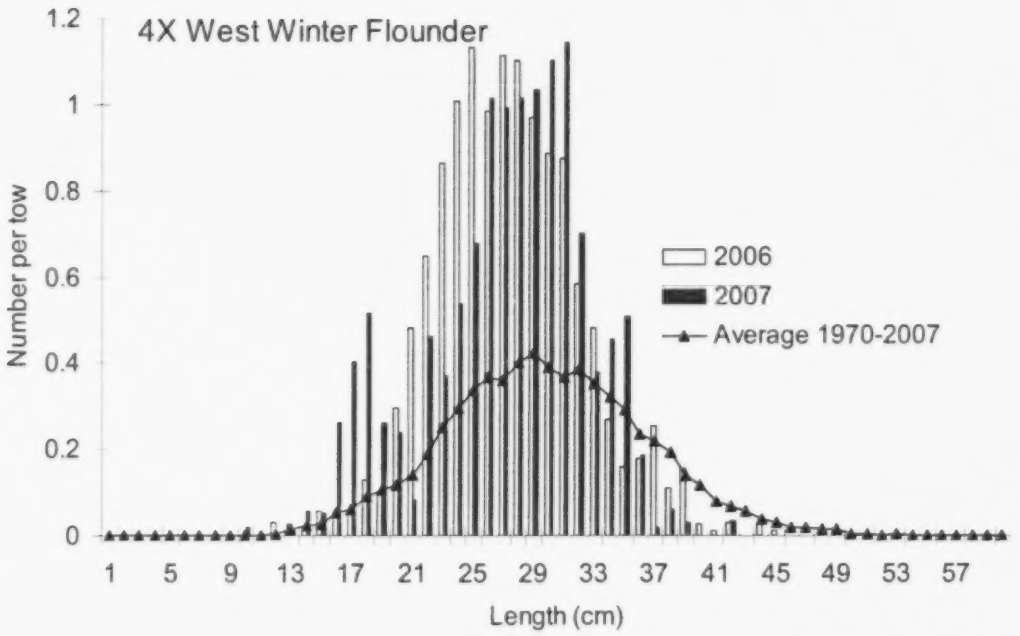

Figure 11d. Length composition for winter flounder in 4X West from the Scotia-Fundy summer RV survey.

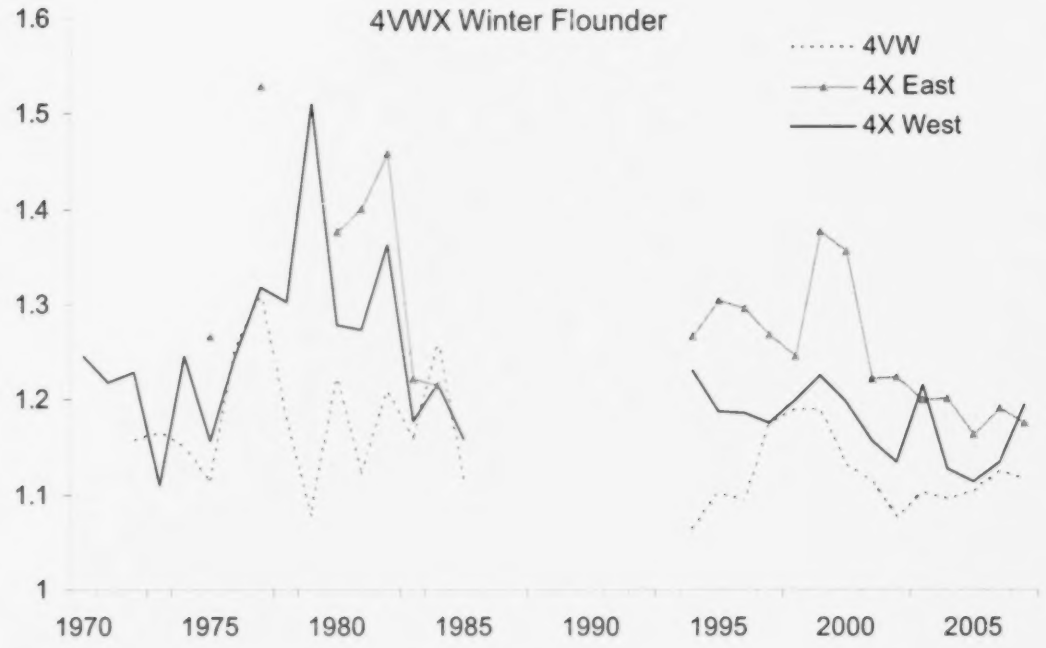

Figure 11e. Condition factor (Fulton's K) for winter flounder from the Scotia-Fundy summer RV survey.

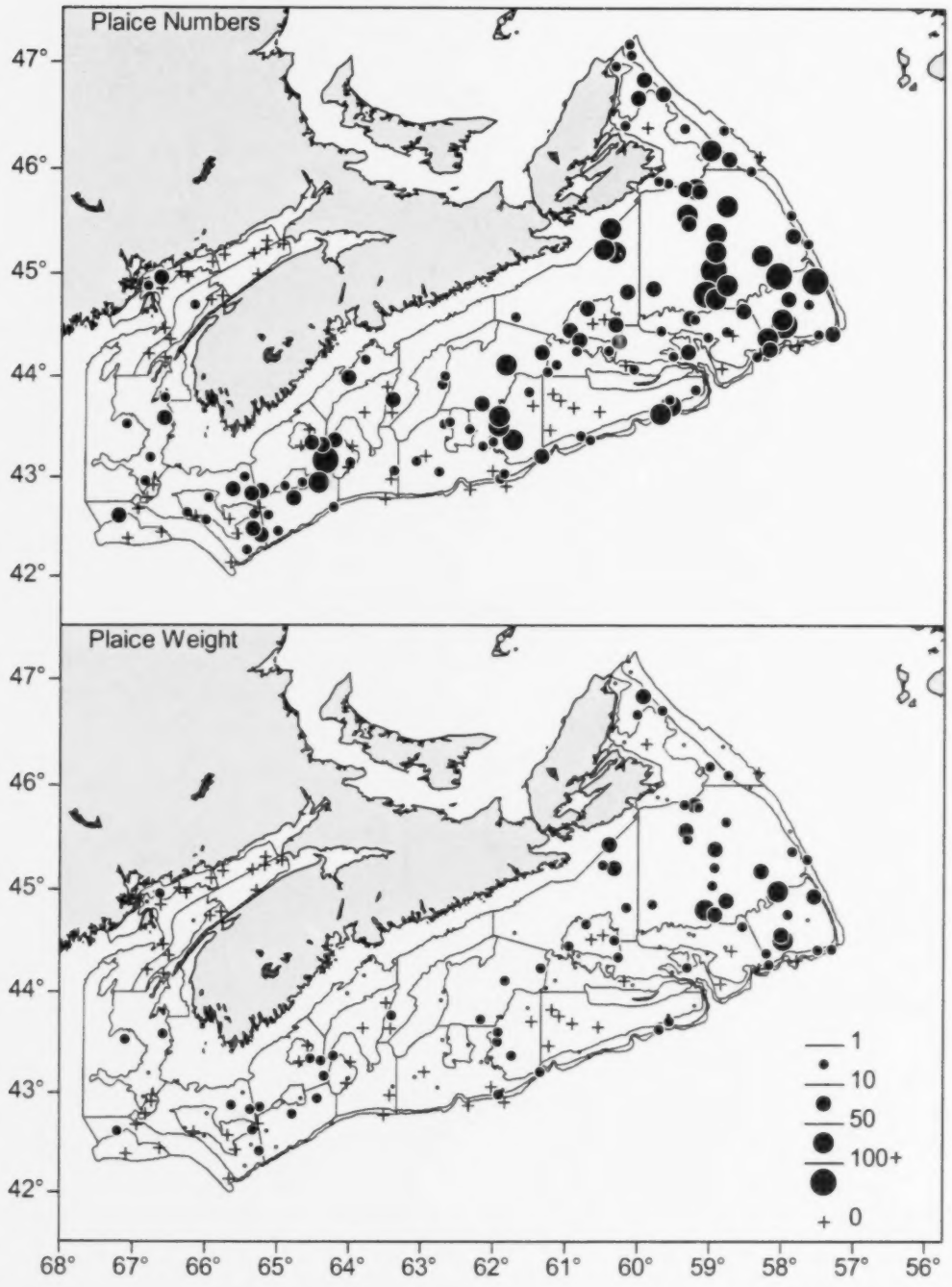

Figure 12a. Distribution of American plaice catches during the 2007 Scotia-Fundy summer RV survey.

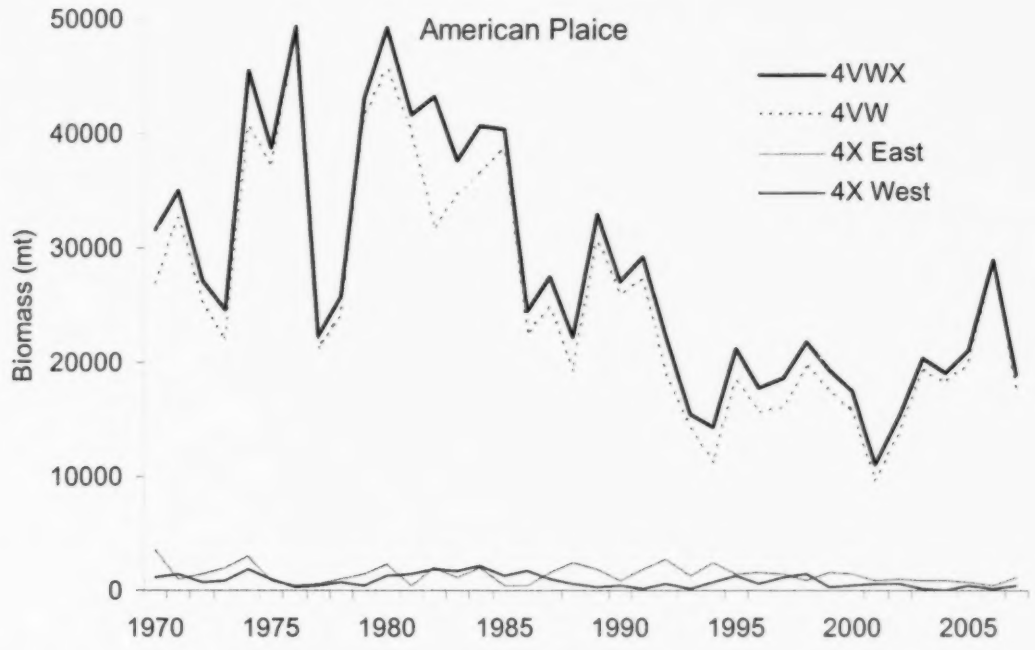

Figure 12b. Biomass estimate for plaice from the Scotia-Fundy summer RV survey.

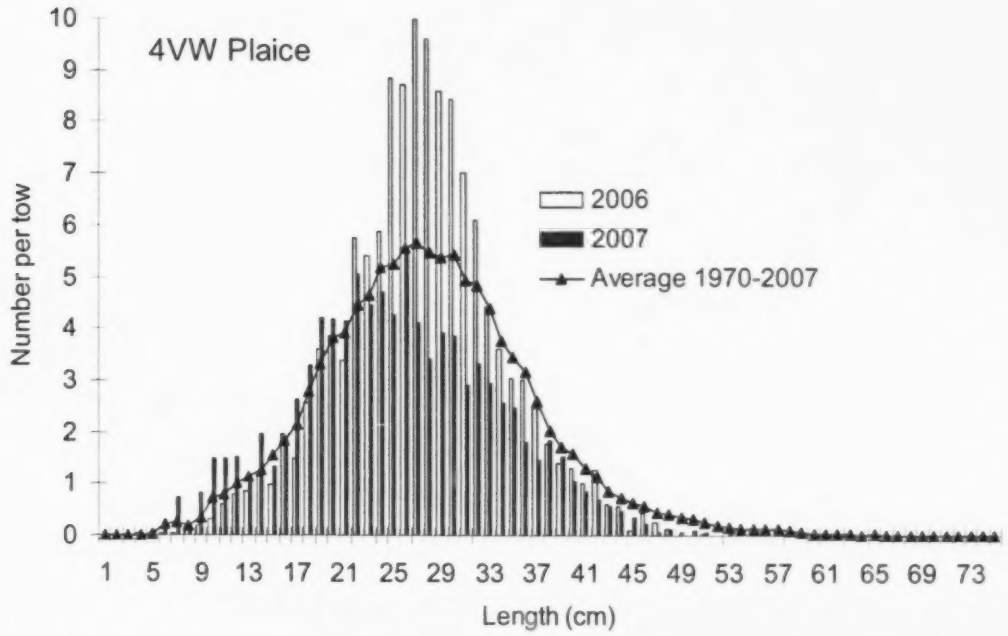

Figure 12c. Length composition for American plaice in 4VW from the Scotia-Fundy summer RV survey.

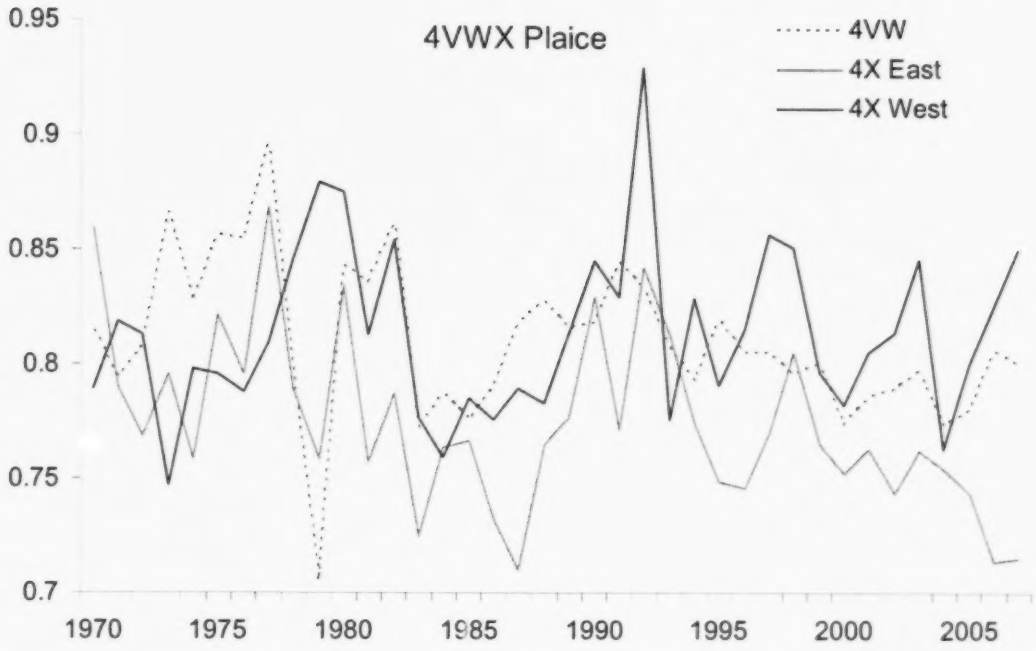

Figure 12d. Condition factor (Fulton's K) for plaice from the Scotia-Fundy summer RV survey.

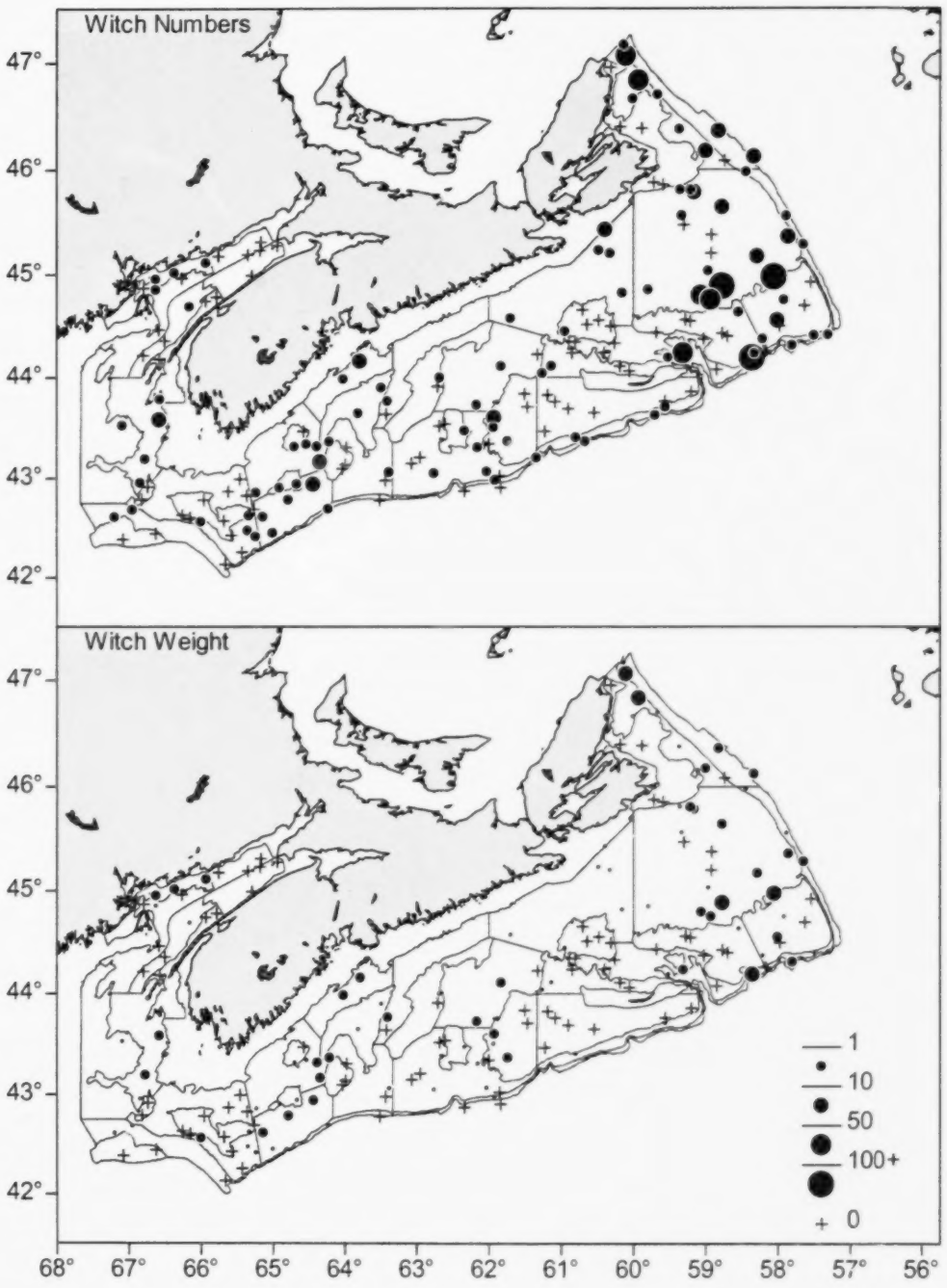

Figure 13a. Distribution of witch flounder catches during the 2007 Scotia-Fundy summer RV survey.

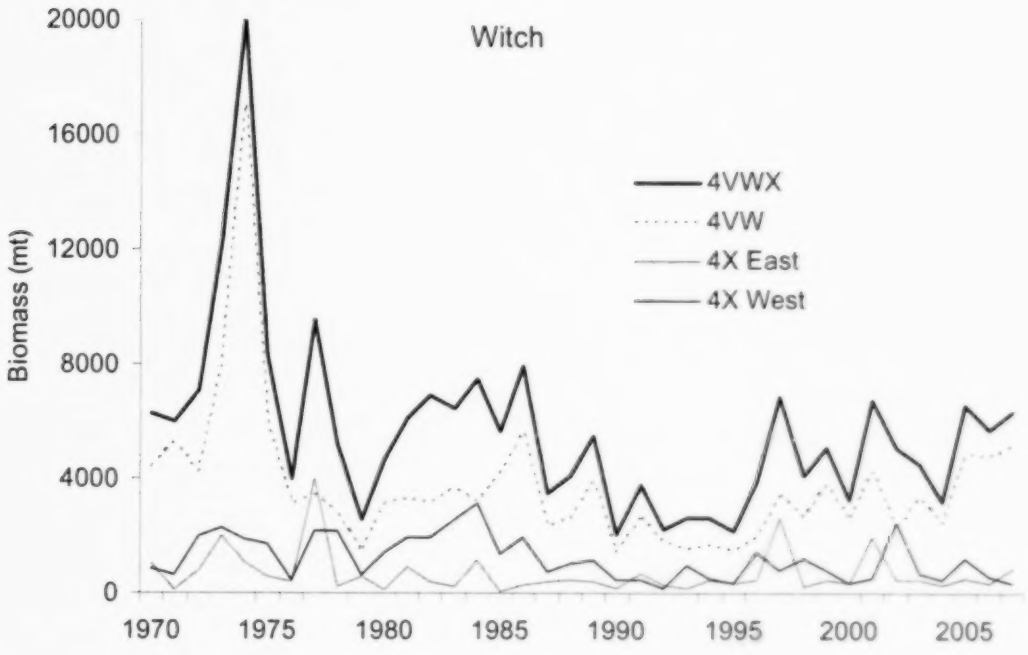

Figure 13b. Biomass estimate for witch flounder from the Scotia-Fundy summer RV survey.

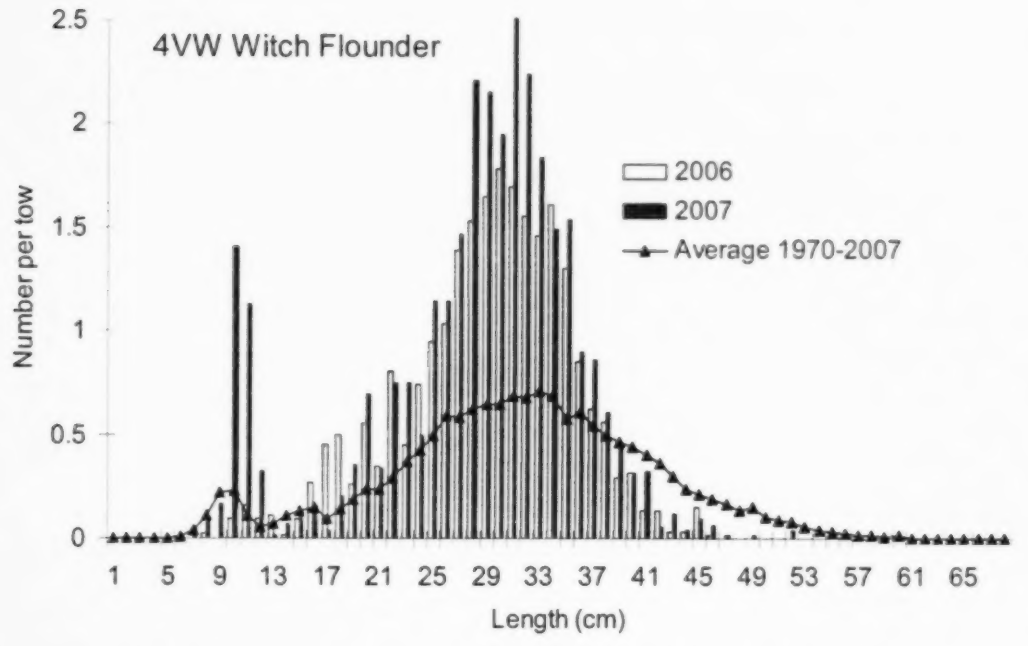

Figure 13c. Length composition for witch flounder in 4VW from the Scotia-Fundy summer RV survey.

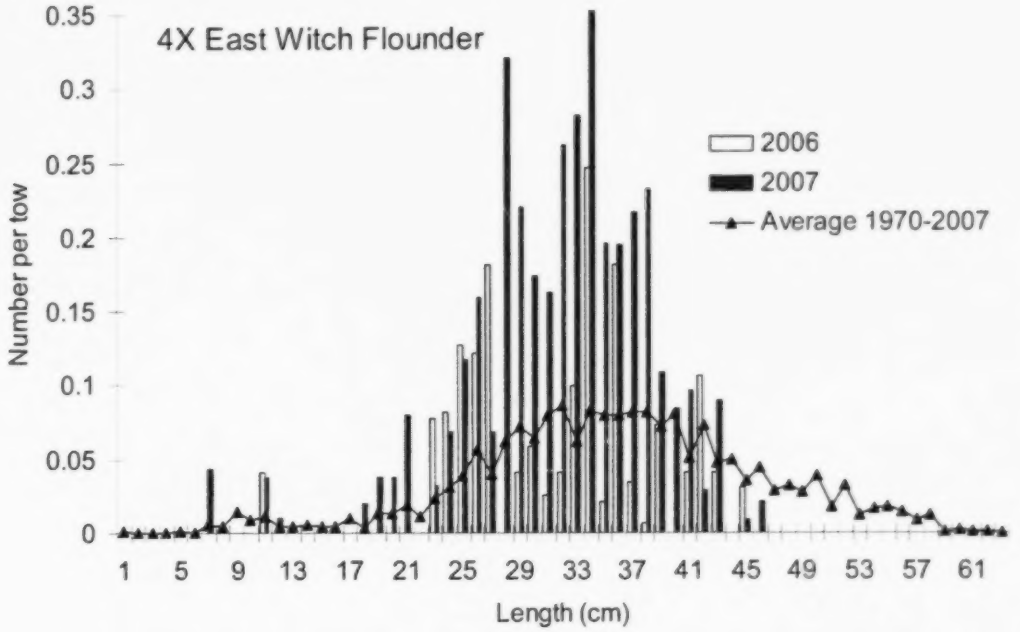

Figure 13d. Length composition for witch flounder in 4X East from the Scotia-Fundy summer RV survey.

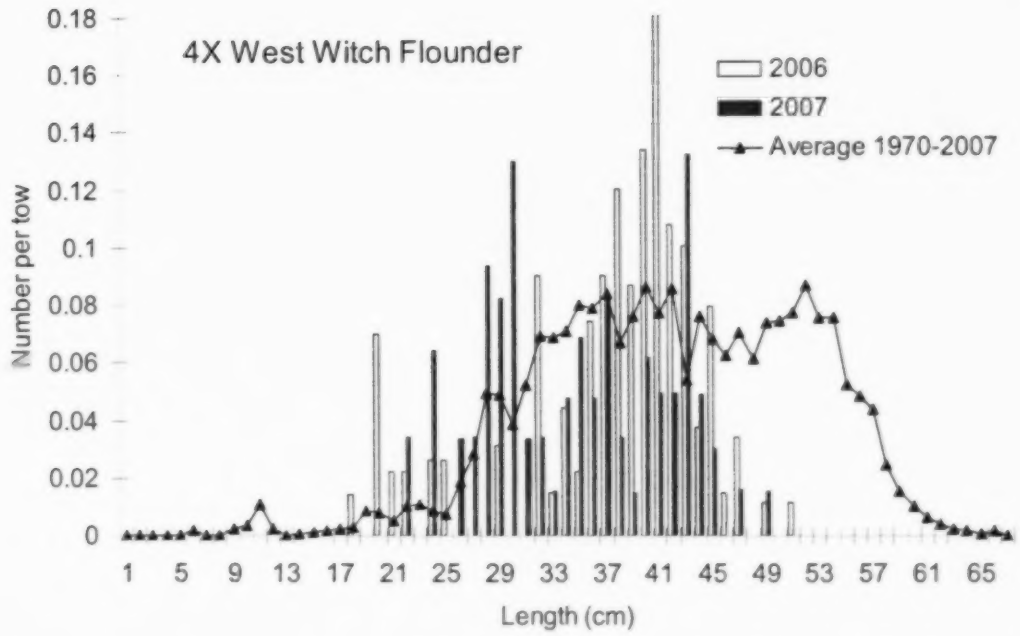

Figure 13e. Length composition for witch flounder in 4X East from the Scotia-Fundy summer RV survey.

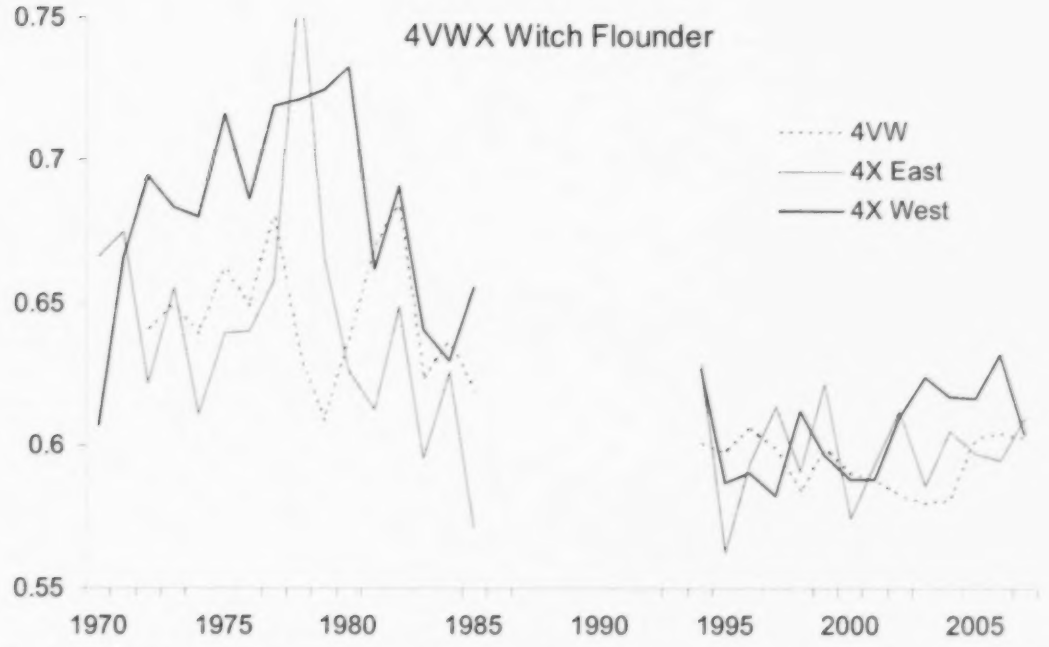

Figure 13f. Condition factor (Fulton's K) for witch flounder from the Scotia-Fundy summer RV survey.

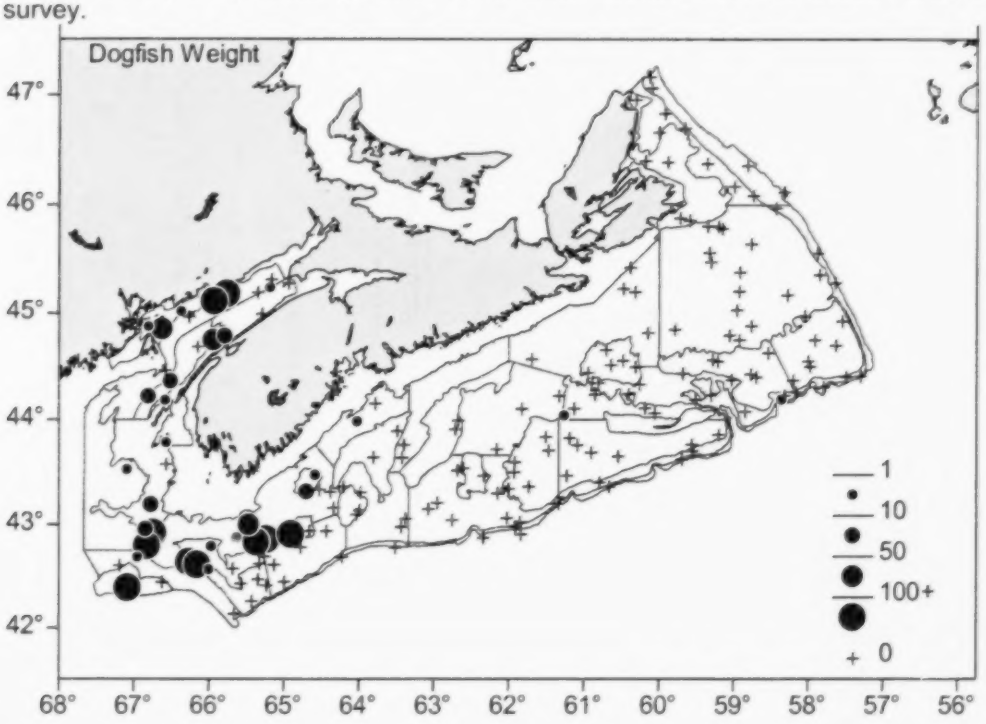

Figure 14a. Distribution of dogfish catches during the 2007 Scotia-Fundy summer RV survey.

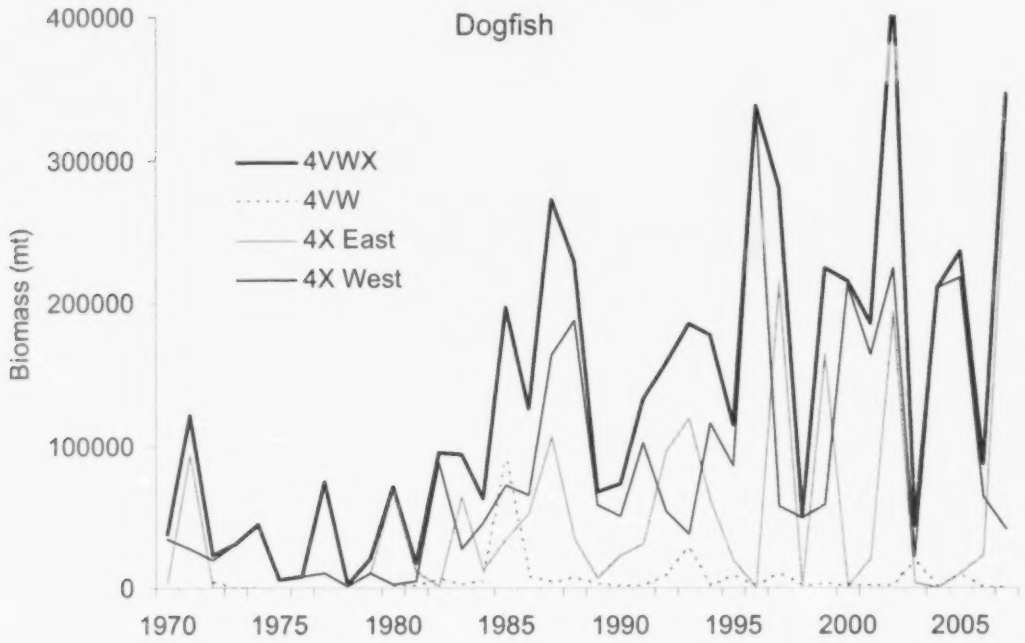

Figure 14b. Biomass estimate for dogfish from the Scotia-Fundy summer RV survey.

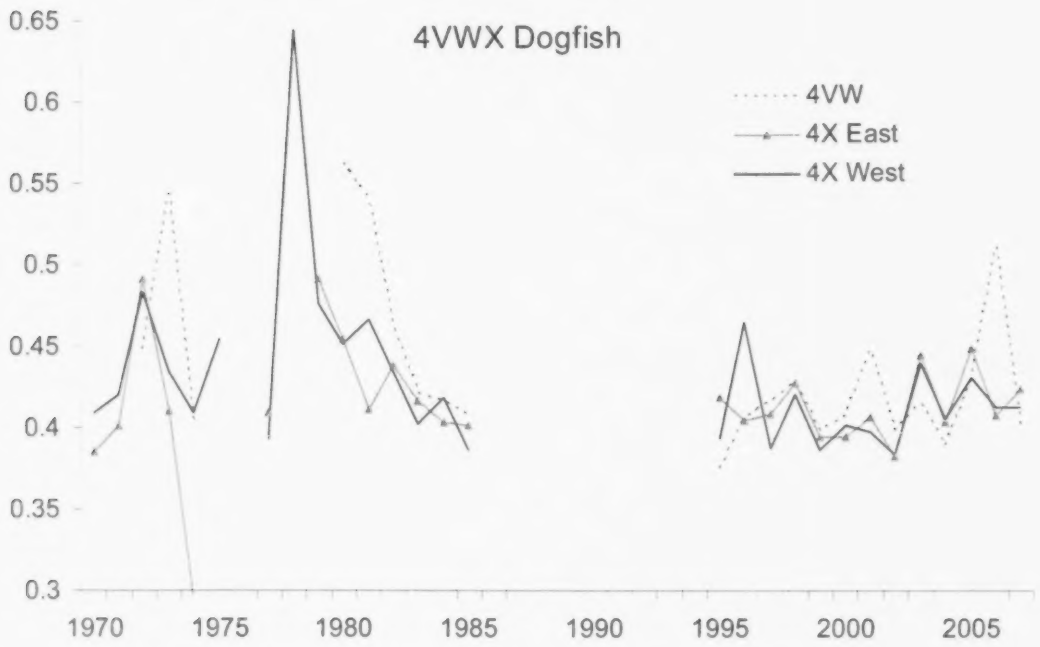

Figure 14c. Condition factor (Fulton's K) for dogfish from the Scotia-Fundy summer RV survey.

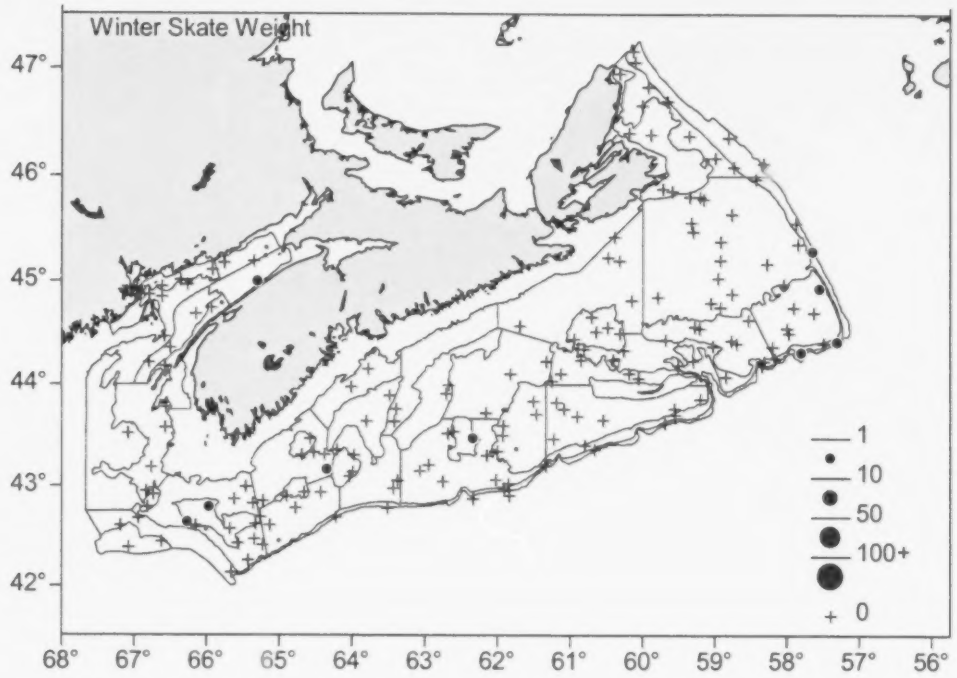

Figure 15a. Distribution of winter skate catches during the 2007 Scotia-Fundy summer RV survey.

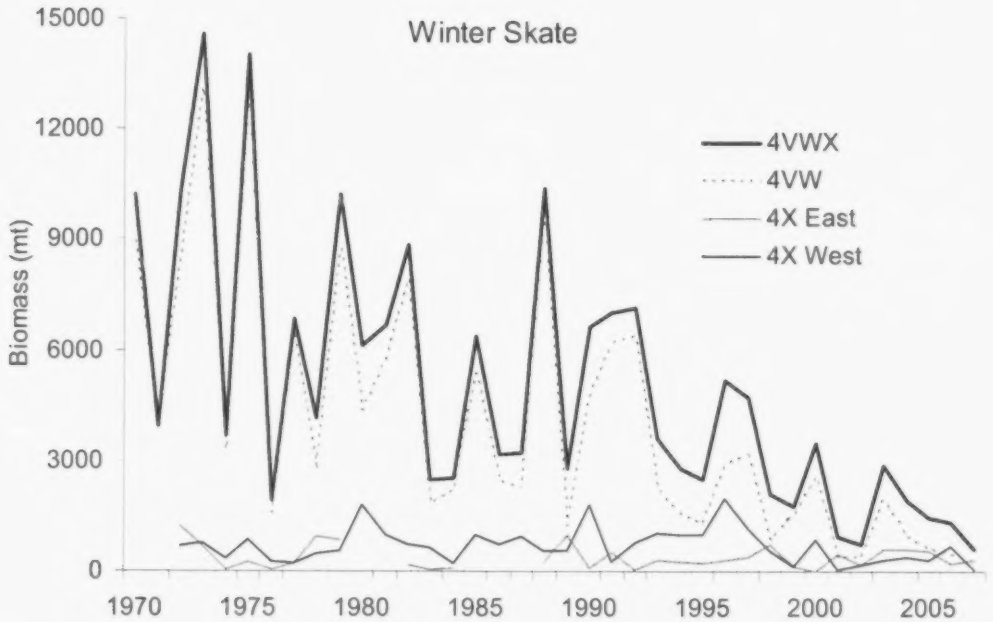

Figure 15b. Biomass estimate for winter skate from the Scotia-Fundy summer RV survey.

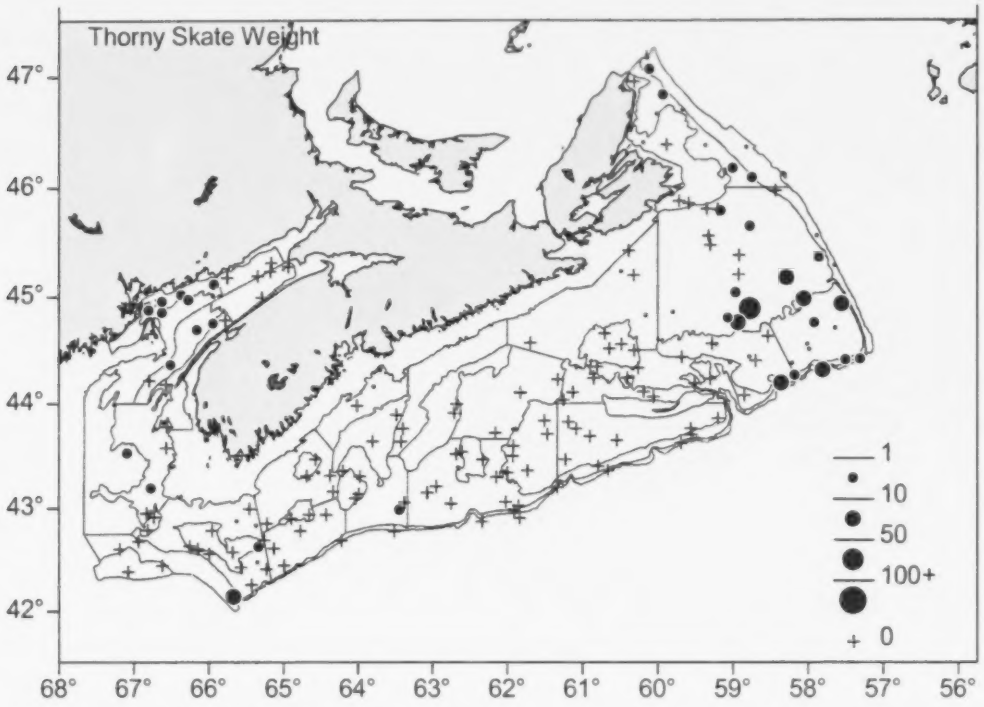

Figure 16a. Distribution of thorny skate catches during the 2007 Scotia-Fundy summer RV survey.

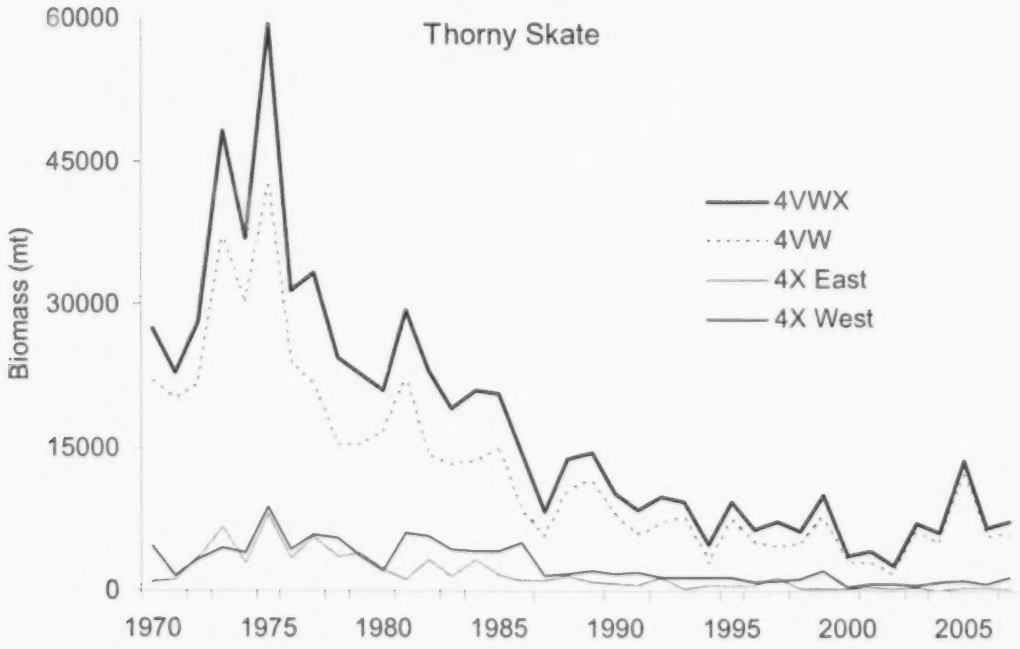

Figure 16b. Biomass estimate for thorny skate from the Scotia-Fundy summer RV survey.

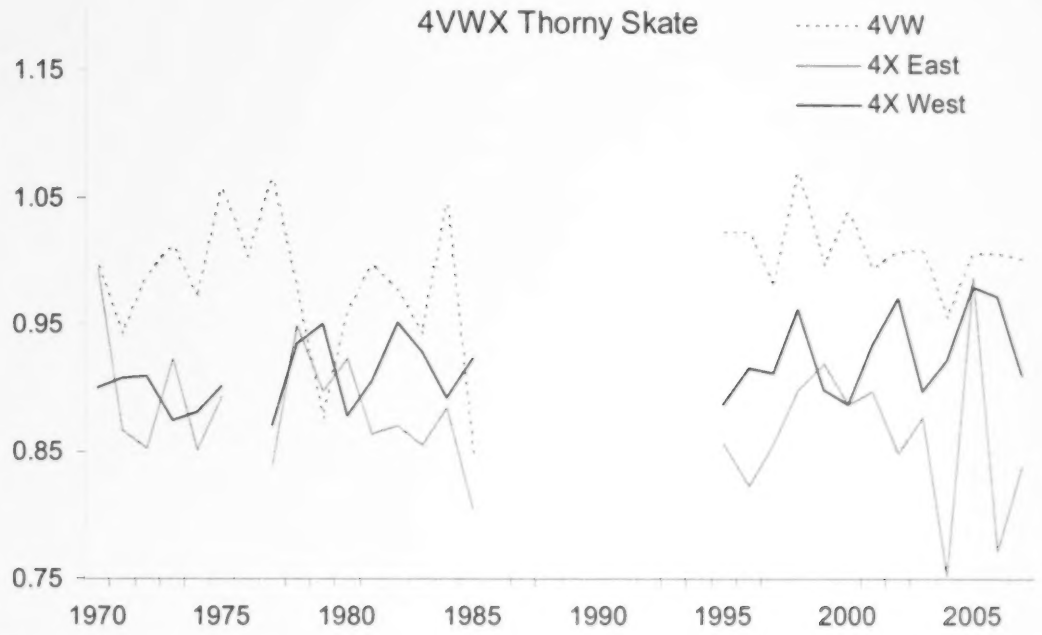

Figure 16c. Condition factor (Fulton's K) for thorny skate from the Scotia-Fundy summer RV survey.

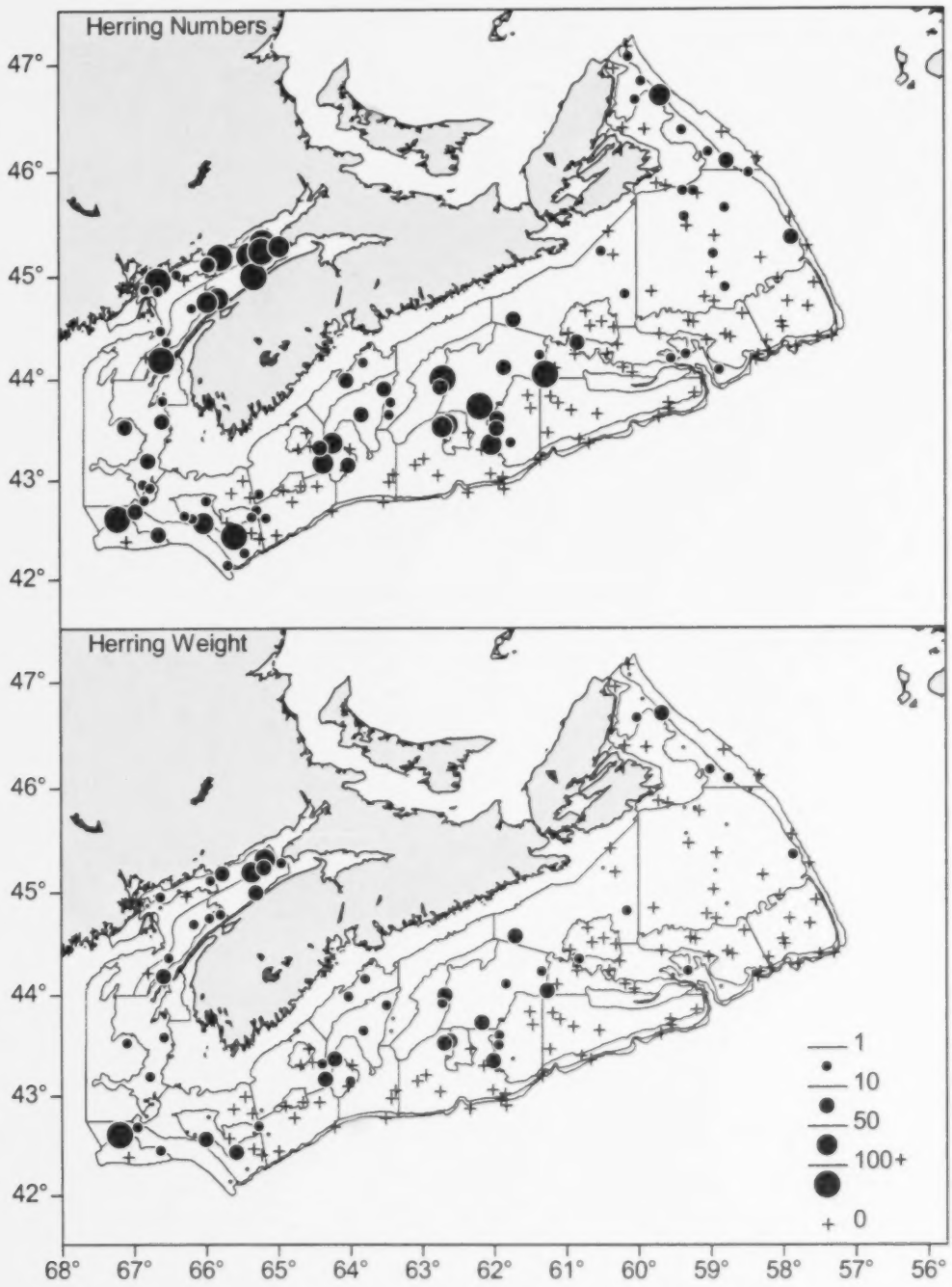

Figure 17a. Distribution of herring catches during the 2007 Scotia-Fundy summer RV survey.

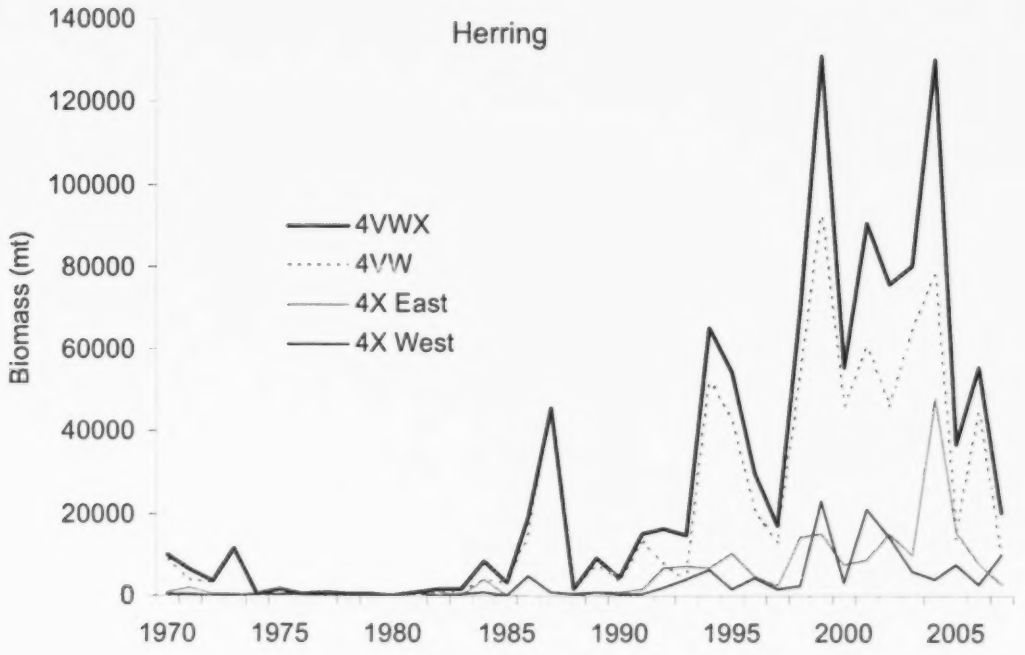

Figure 17b. Biomass estimate for herring from the Scotia-Fundy summer RV survey.

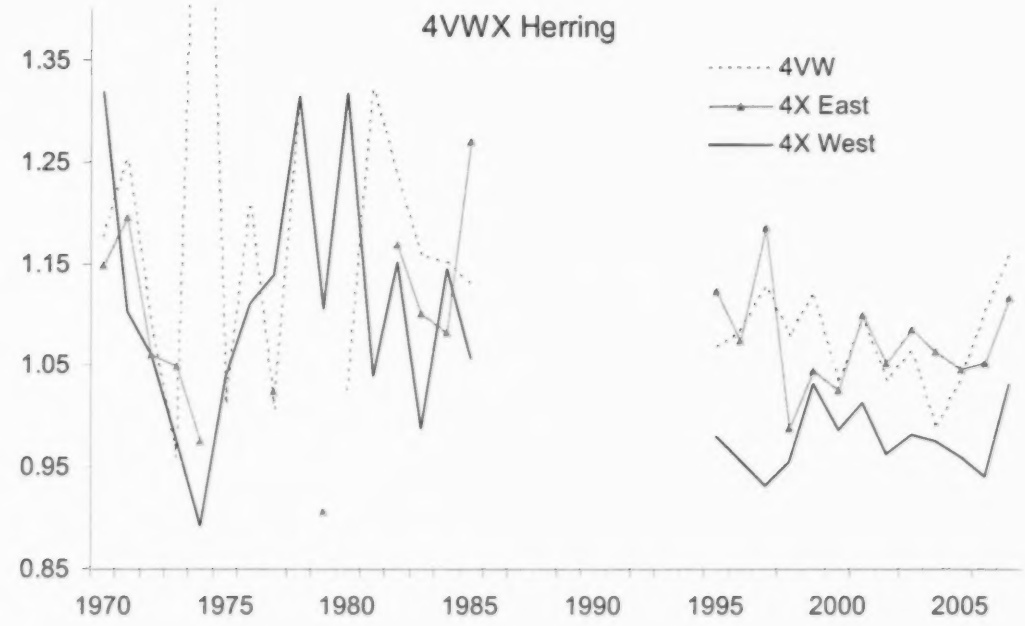

Figure 17c. Condition factor (Fulton's K) for herring from the Scotia-Fundy summer RV survey.

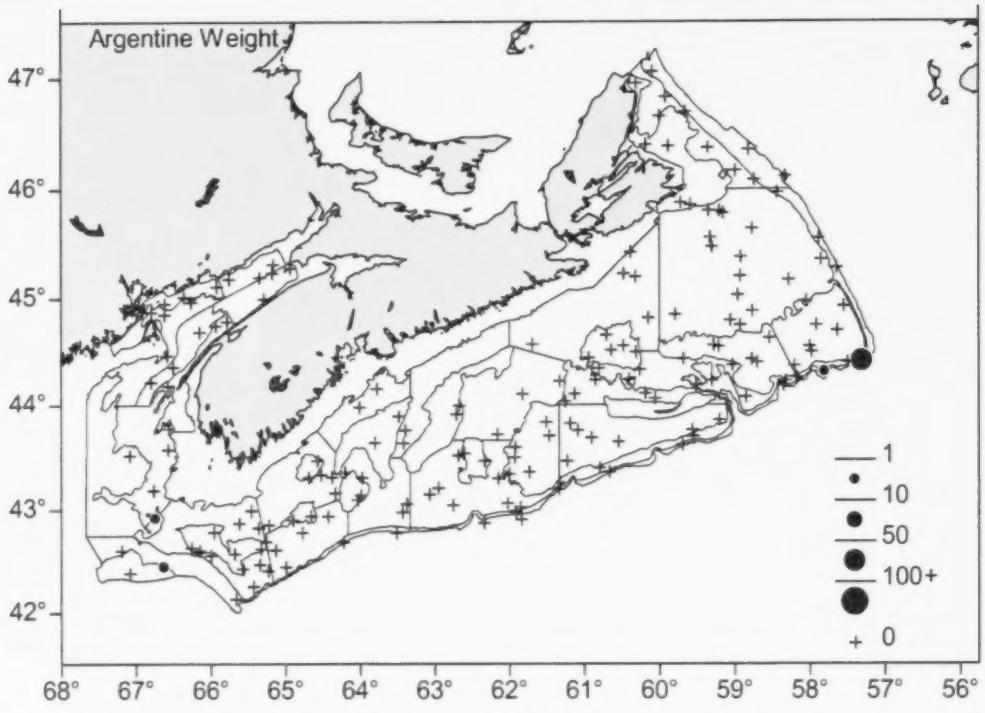

Figure 18a. Distribution of argentine catches during the 2007 Scotia-Fundy summer RV survey.

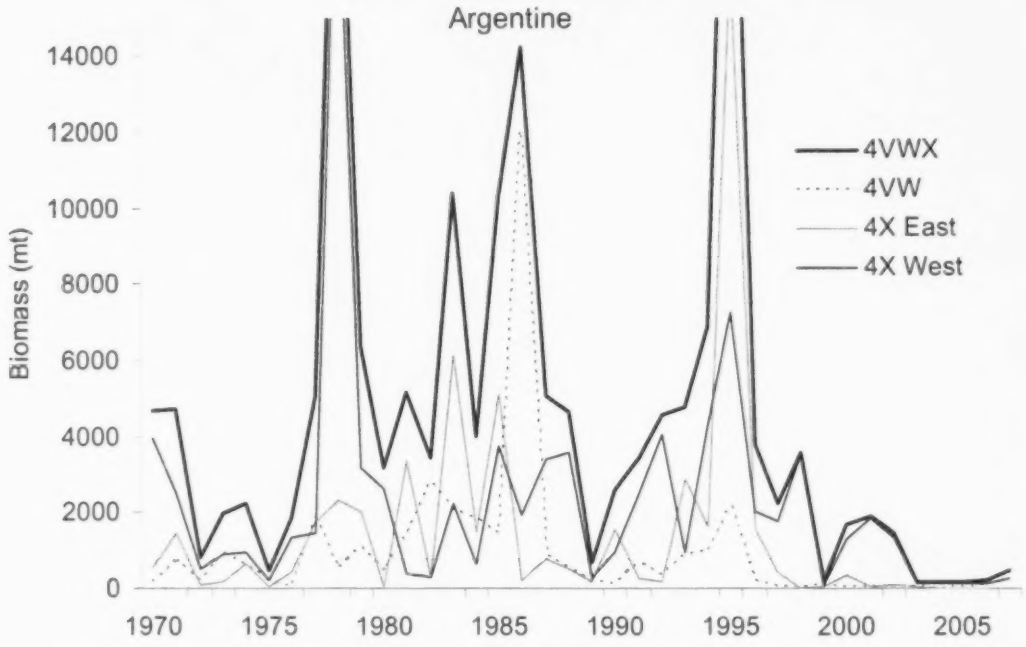

Figure 18b. Biomass estimate for argentine from the Scotia-Fundy summer RV survey.

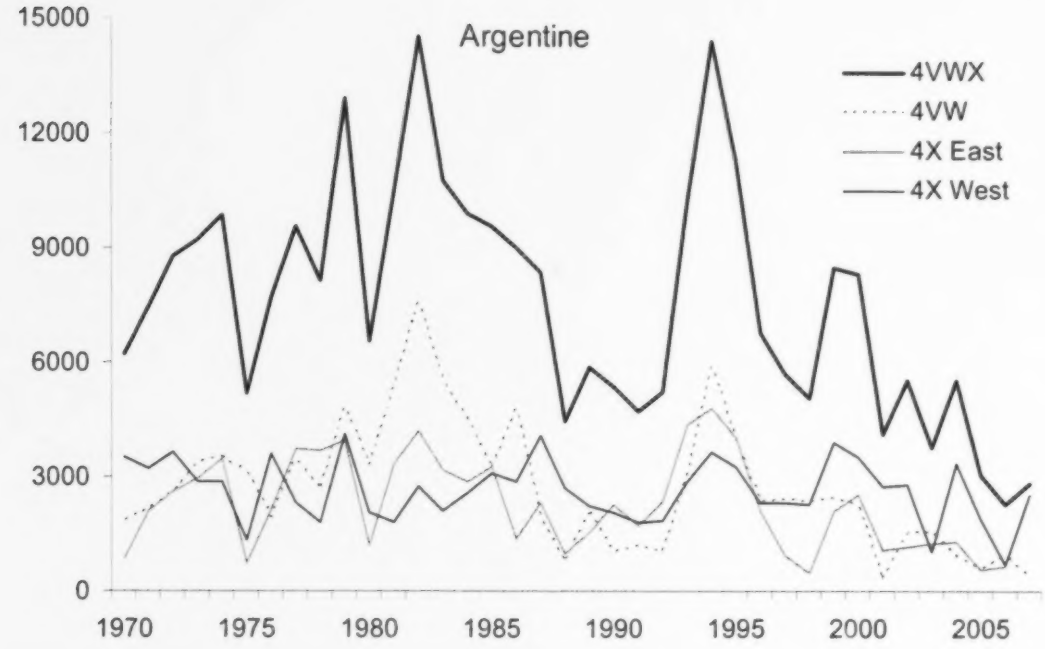

Figure 18c. Stratified area occupied by argentine from the Scotia-Fundy summer RV survey.

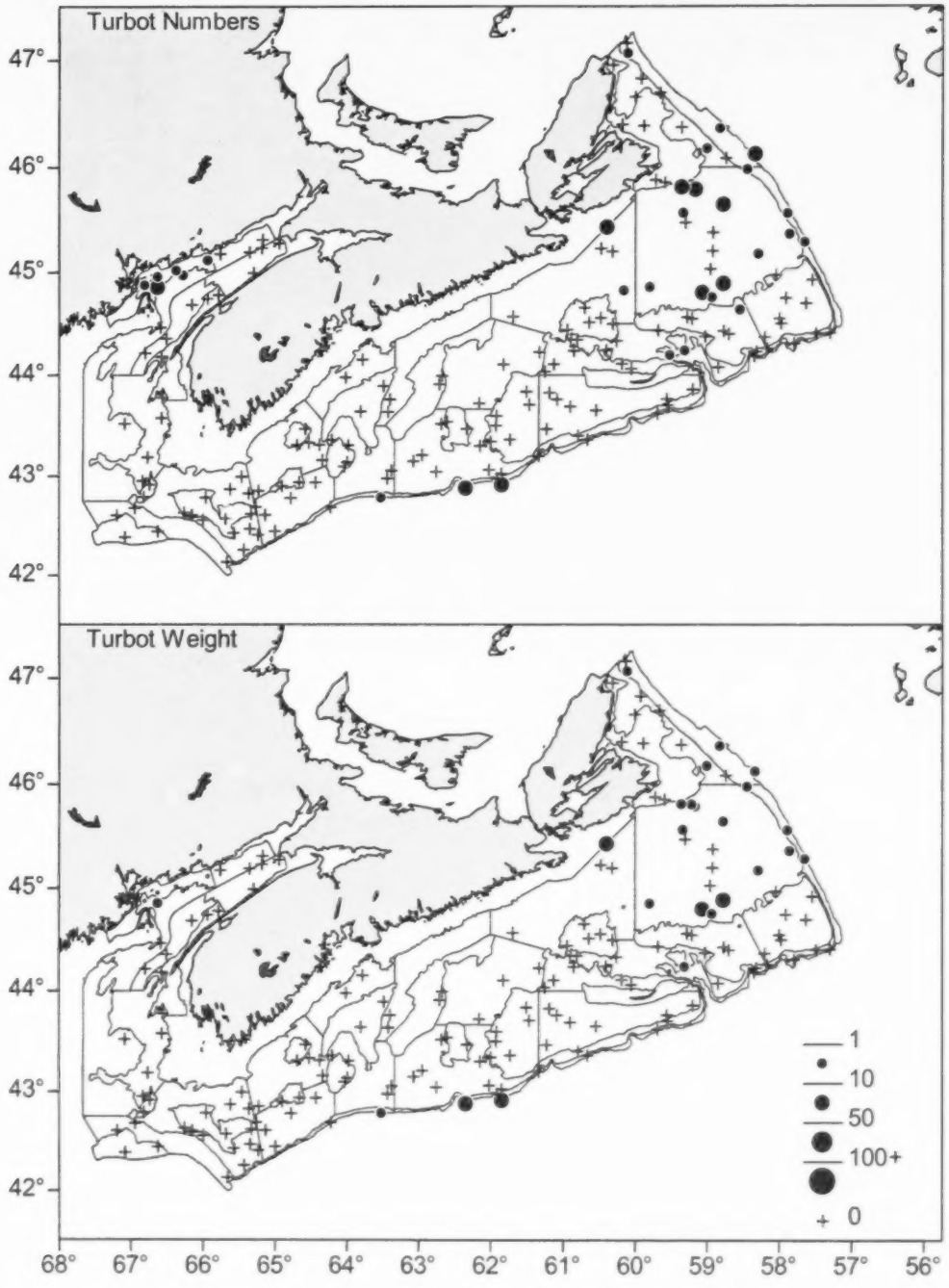

Figure 19a. Distribution of turbot catches during the 2007 Scotia-Fundy summer RV survey.

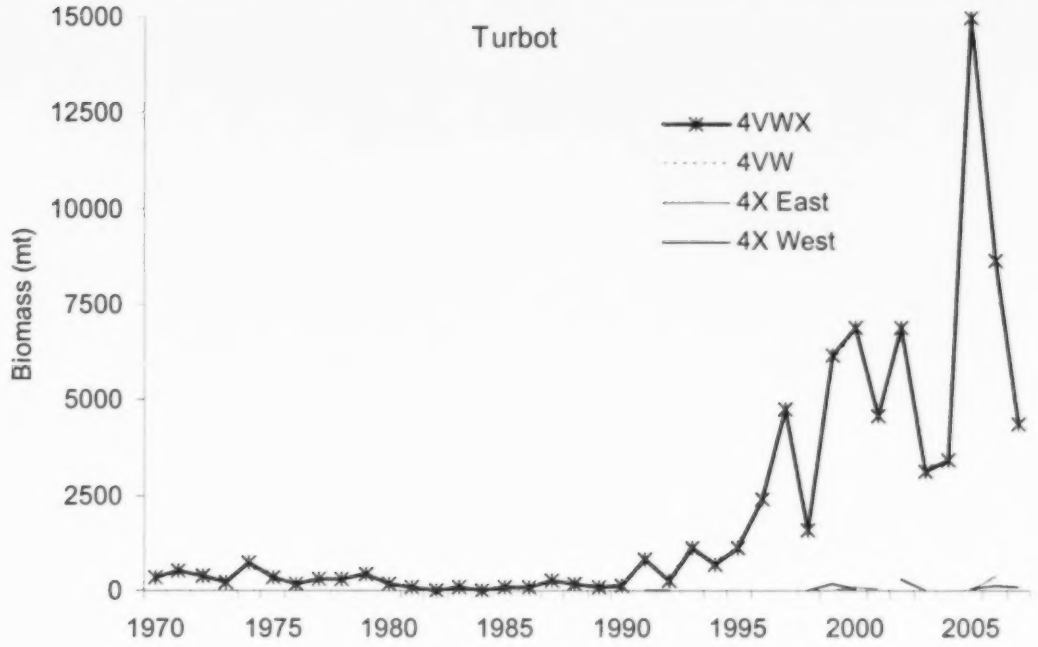

Figure 19b. Biomass estimate for turbot from the Scotia-Fundy summer RV survey.

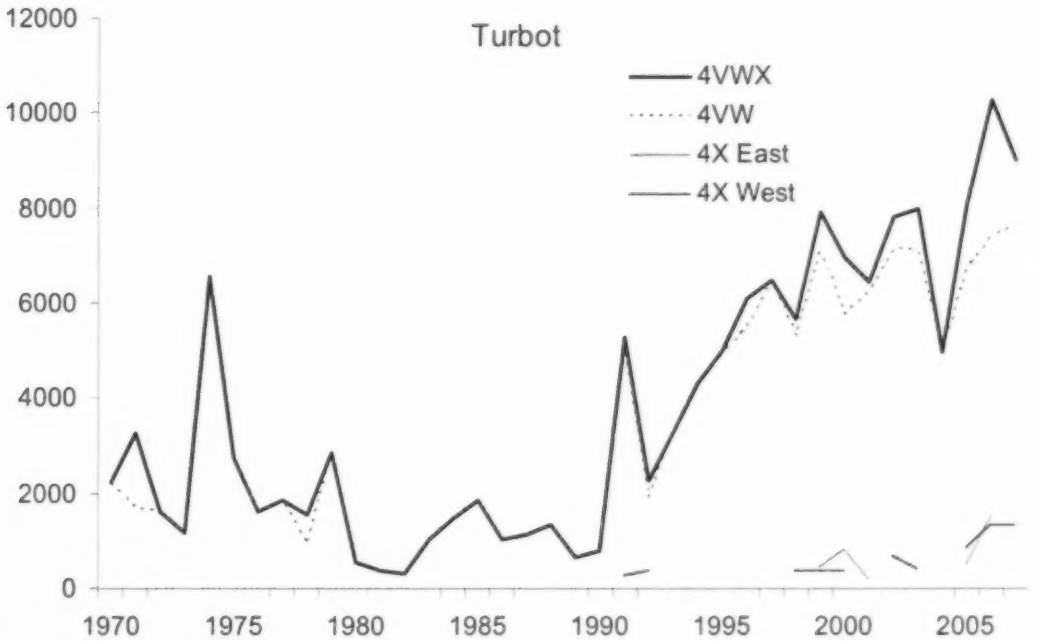

Figure 19c. Stratified area occupied by turbot from the Scotia-Fundy summer RV survey.

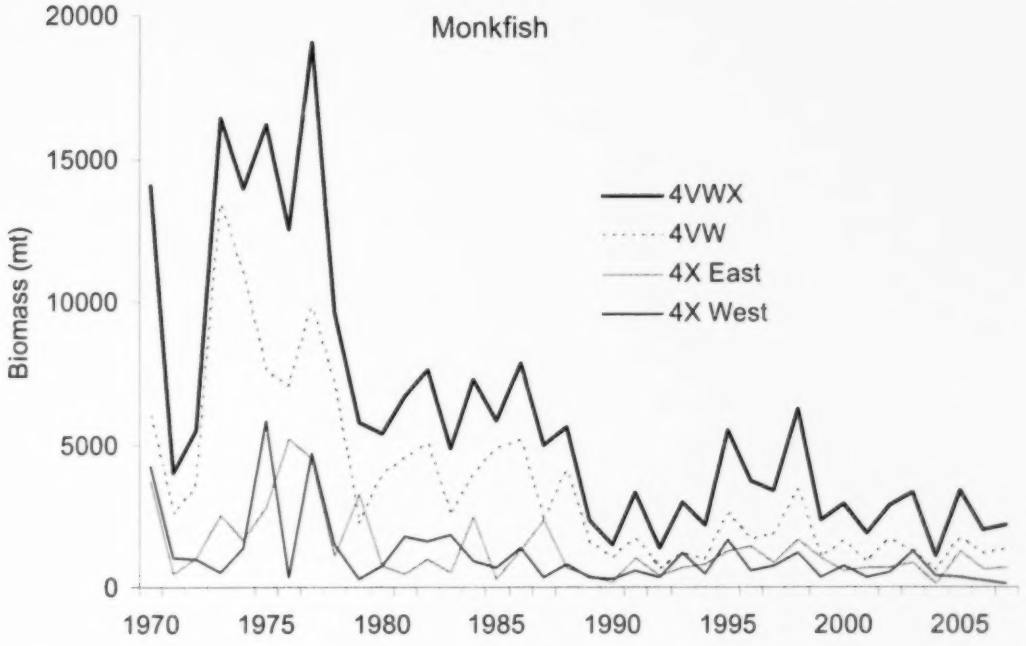

Figure 20. Biomass estimate for monkfish from the Scotia-Fundy summer RV survey.

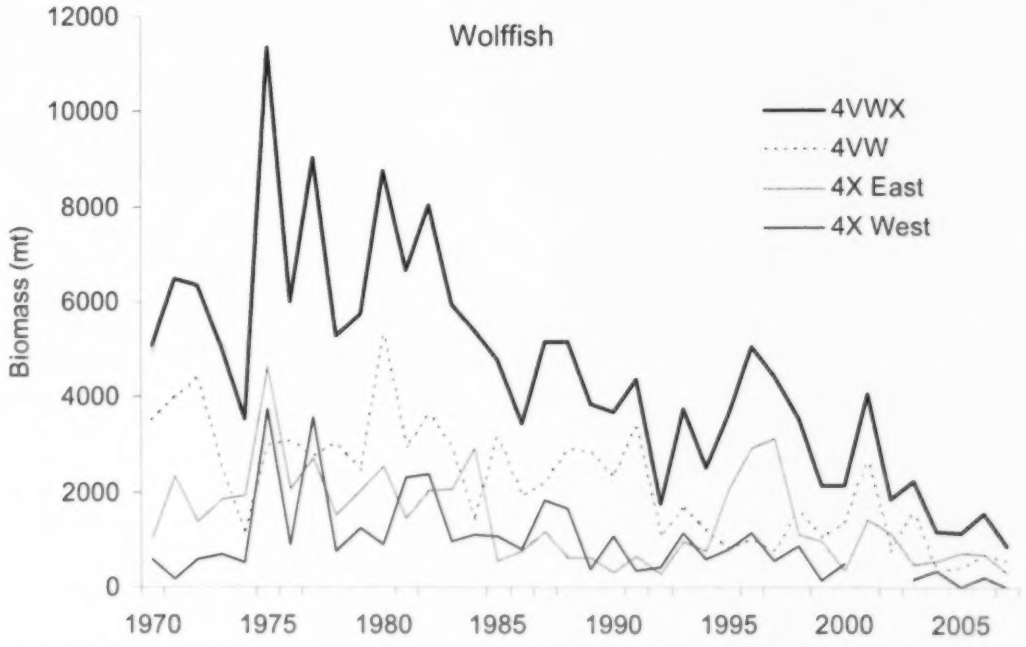

Figure 21. Biomass estimate for wolffish from the Scotia-Fundy summer RV survey.

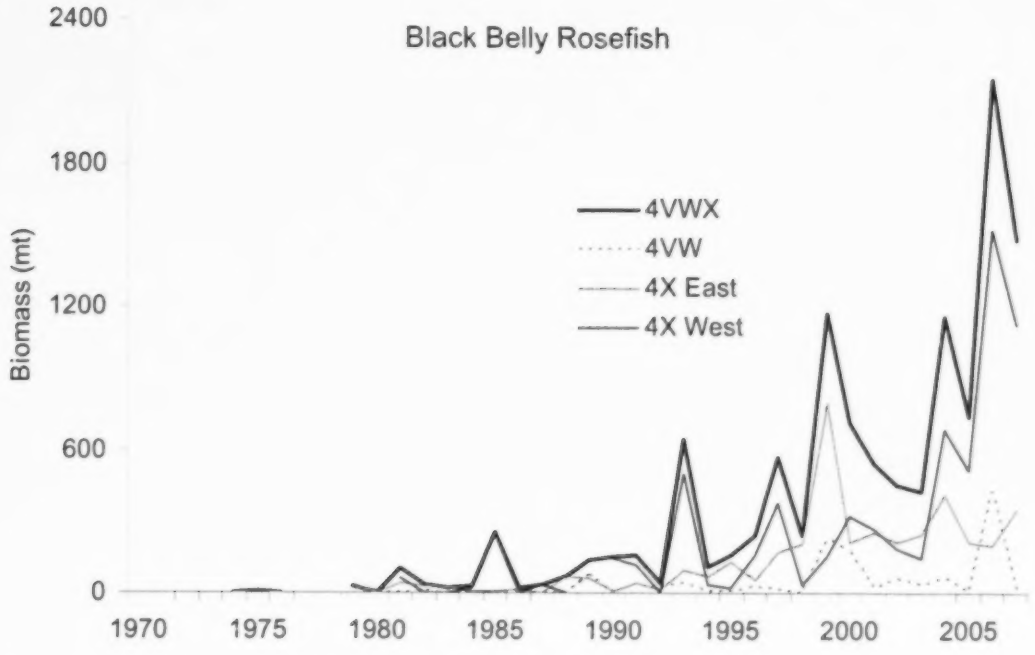

Figure 22. Biomass estimate for rosefish from the Scotia-Fundy summer RV survey.

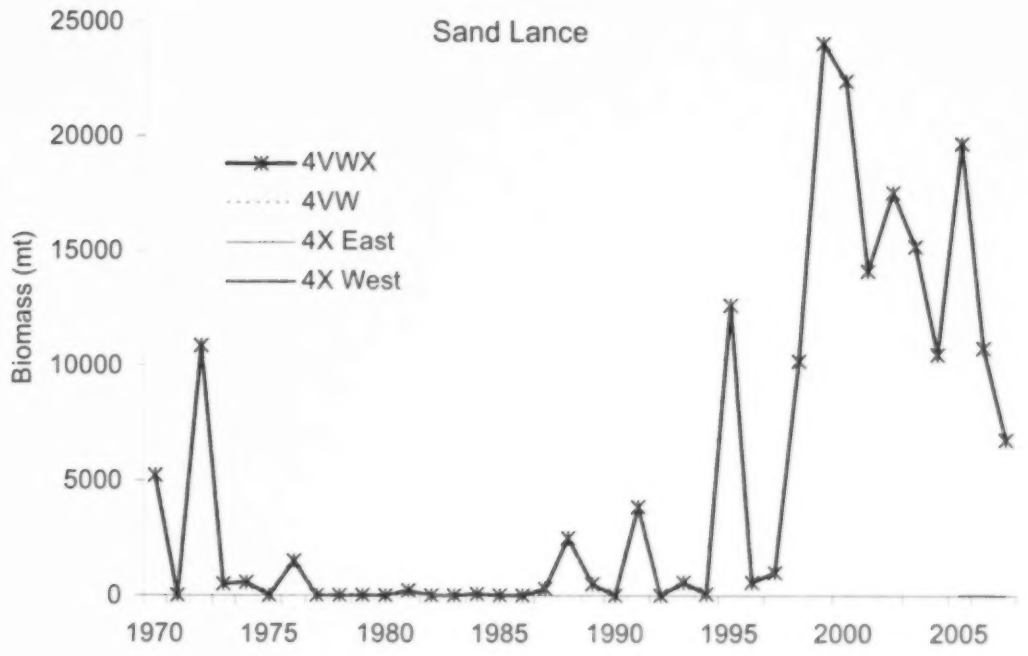

Figure 23. Biomass estimate for sand lance from the Scotia-Fundy summer RV survey.

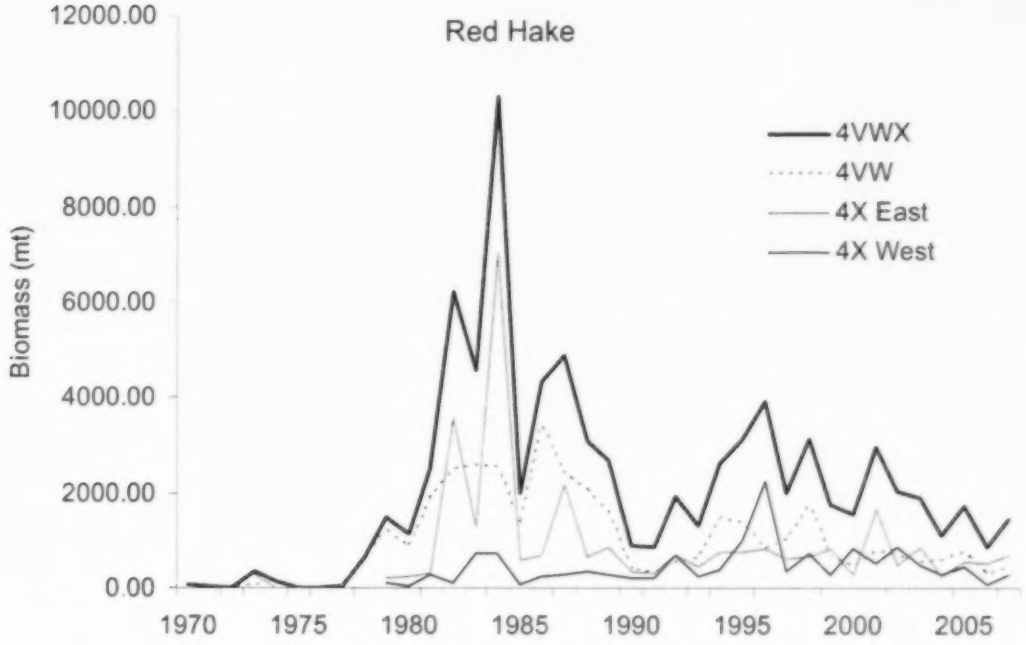

Figure 24. Biomass estimate for red hake from the Scotia-Fundy summer RV survey.

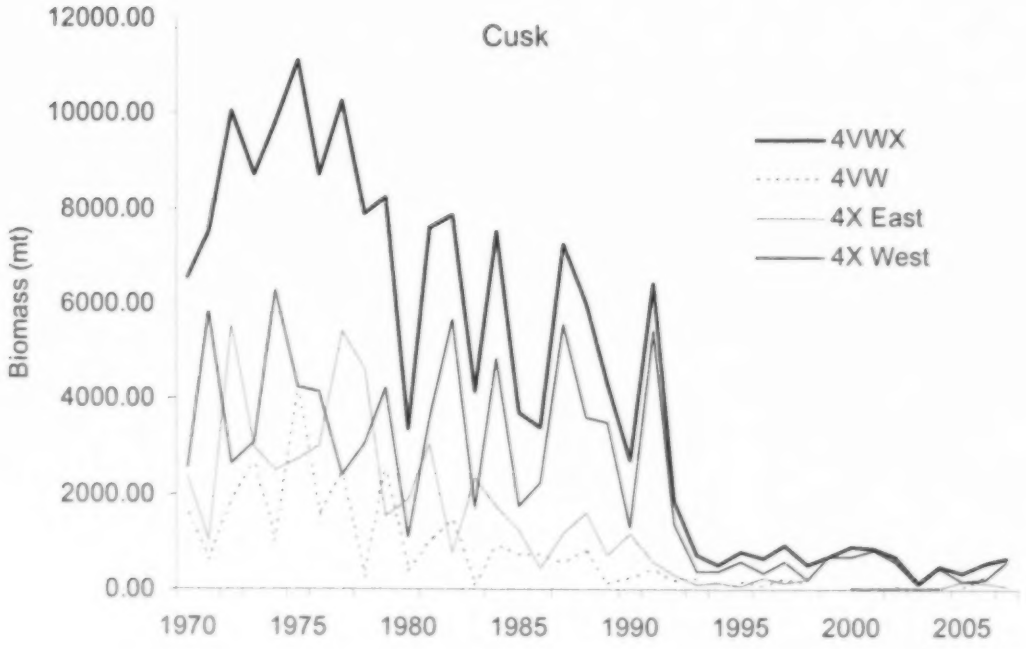

Figure 25a. Biomass estimate for cusk from the Scotia-Fundy summer RV survey.

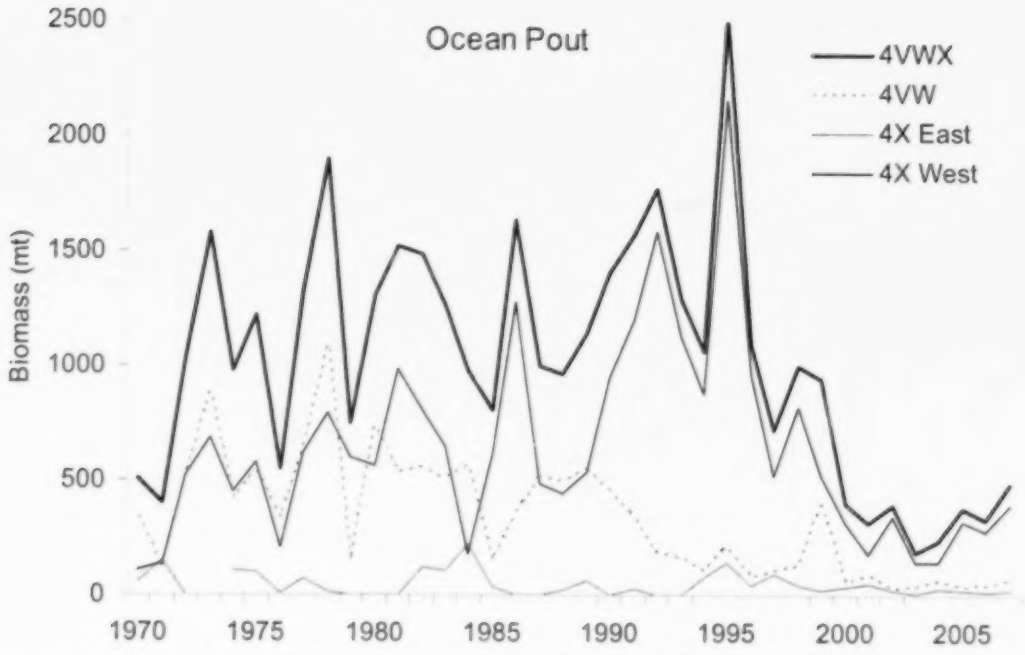

Figure 26. Biomass estimate for ocean pout from the Scotia-Fundy summer RV survey.

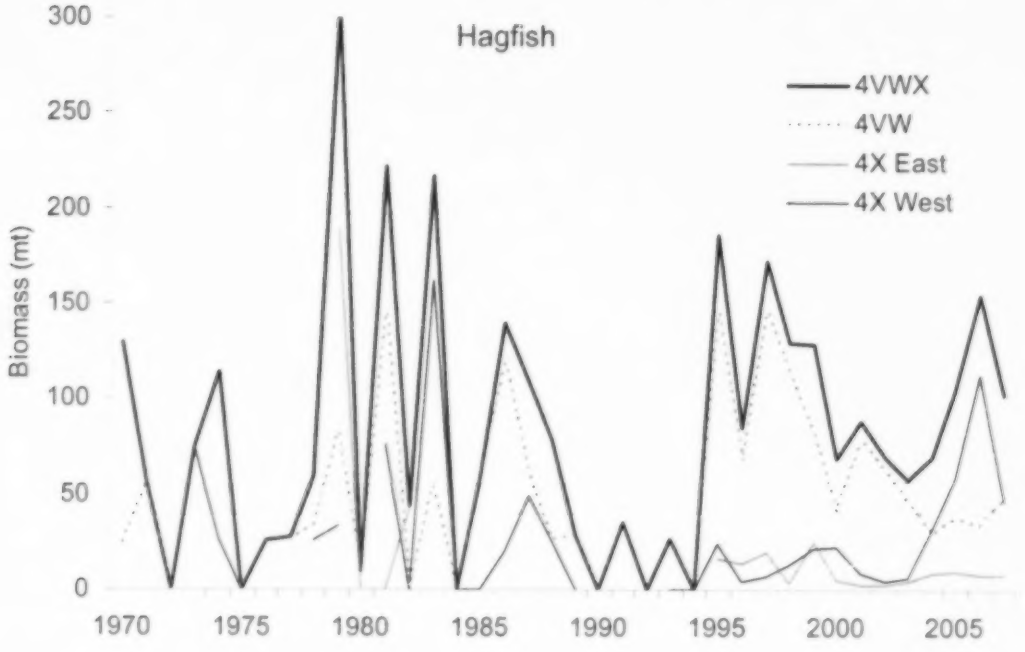

Figure 27. Biomass estimate for hagfish from the Scotia-Fundy summer RV survey.

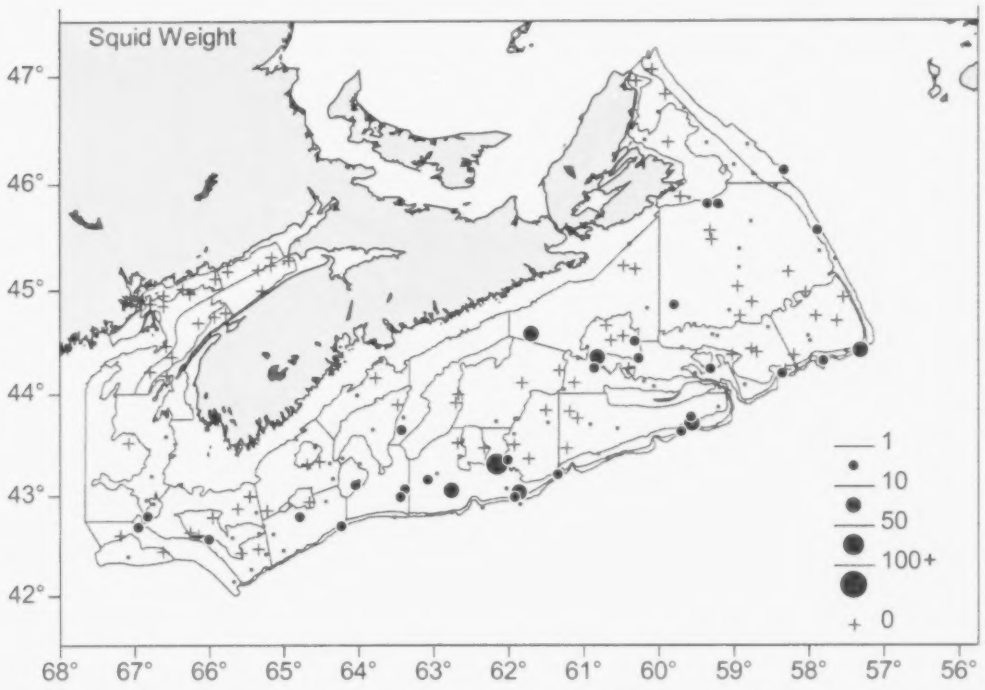

Figure 28a. Distribution of squid catches during the 2007 Scotia-Fundy summer RV survey.

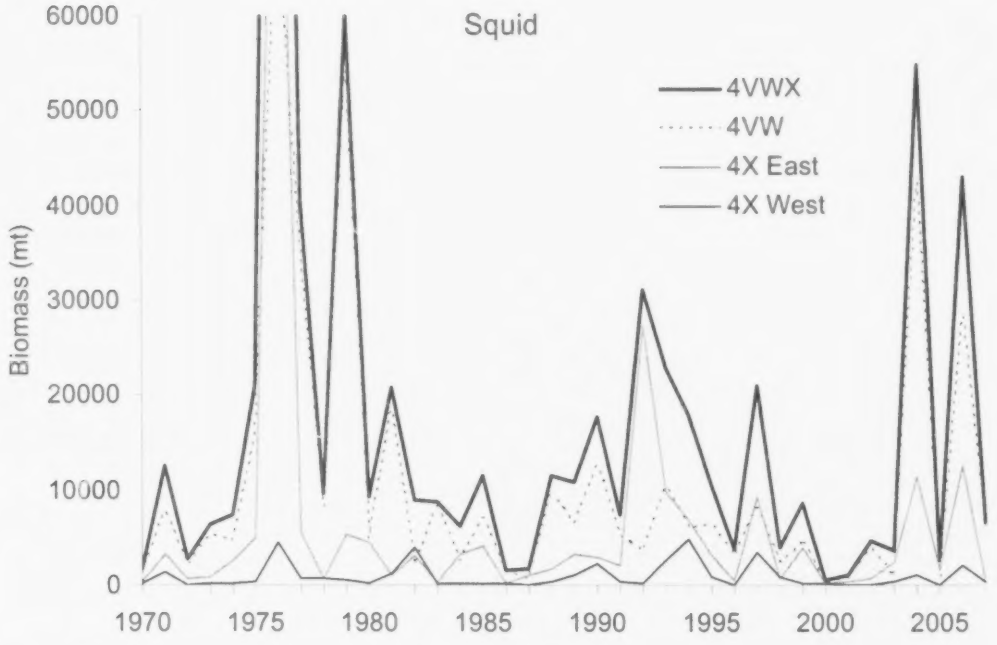

Figure 28b. Biomass estimate for squid from the Scotia-Fundy summer RV survey.

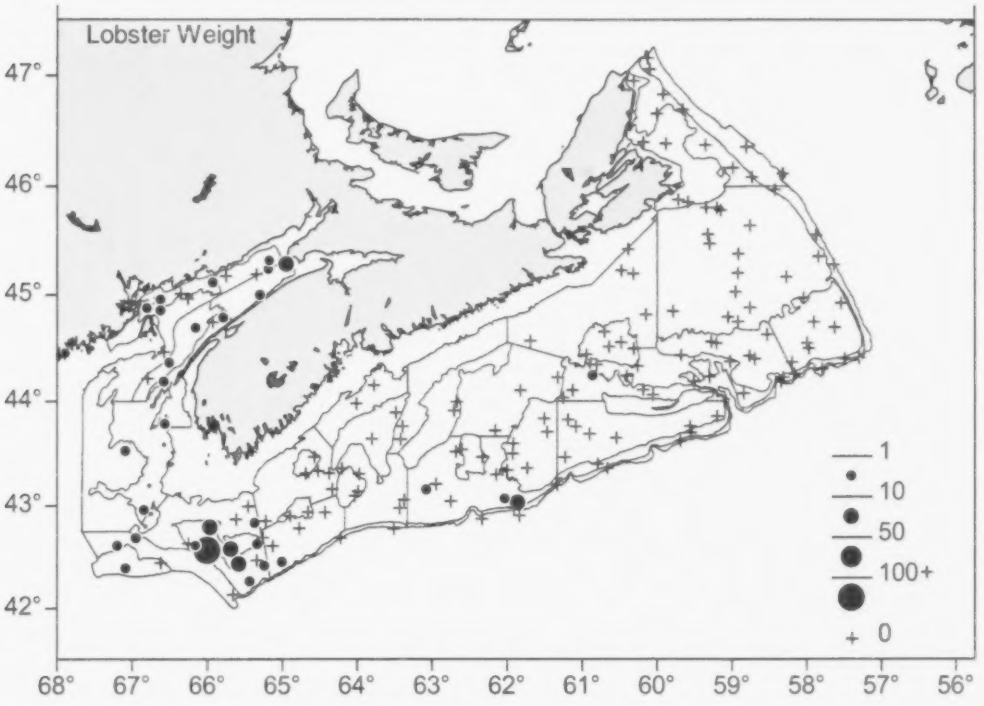

Figure 29a. Distribution of lobster catches during the 2007 Scotia-Fundy summer RV survey.

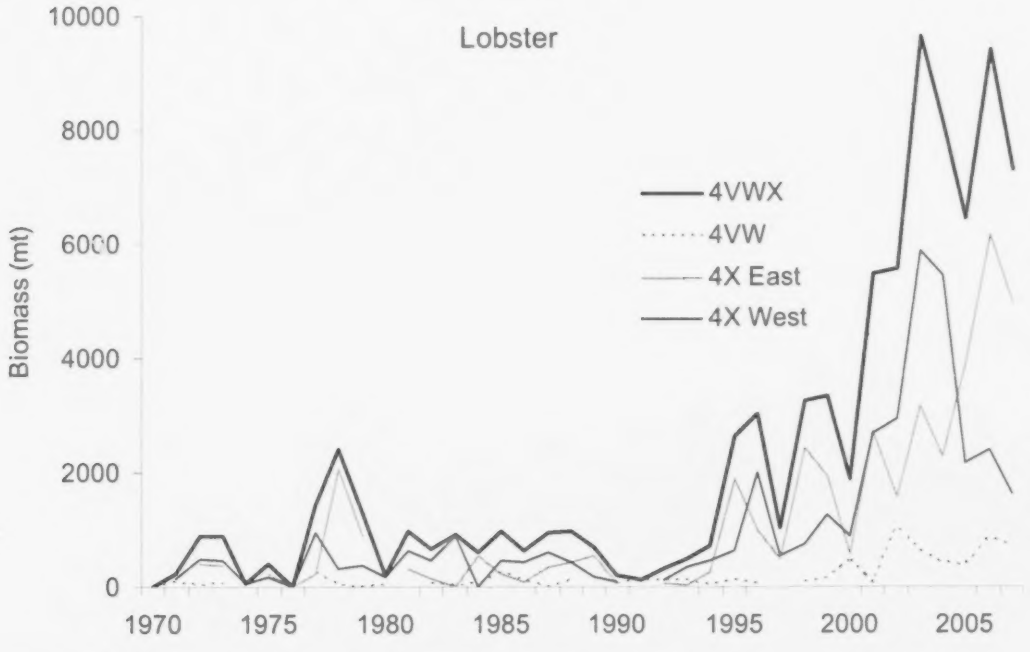

Figure 29b. Biomass estimate for lobster from the Scotia-Fundy summer RV survey.

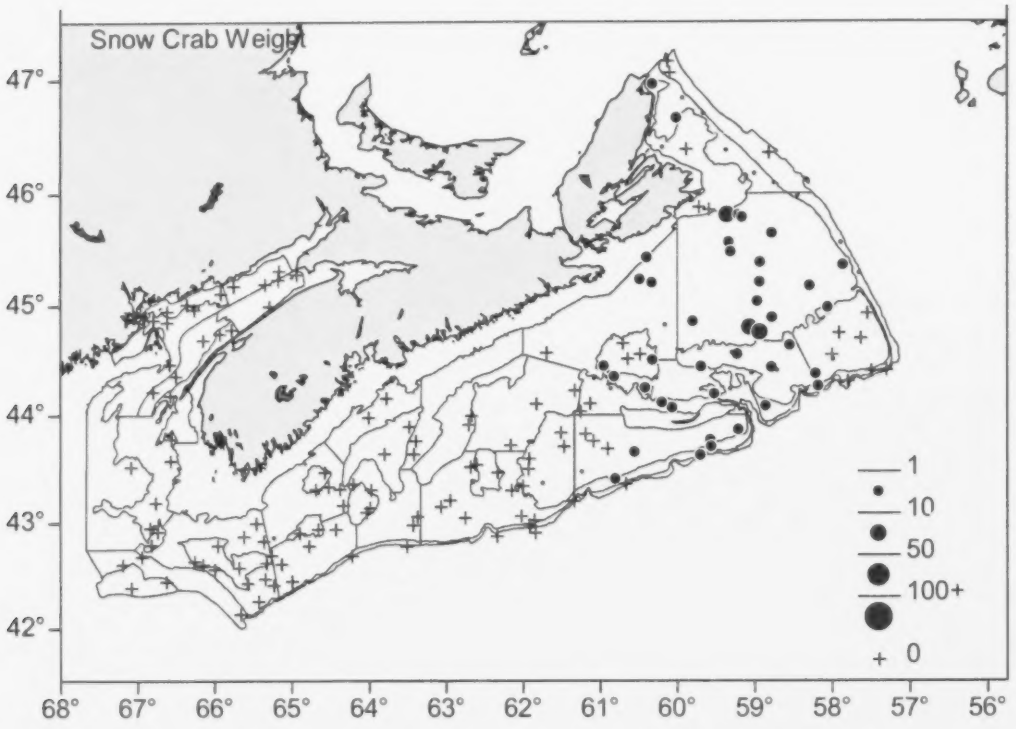

Figure 30a. Distribution of snow crab catches during the 2007 Scotia-Fundy summer RV survey.

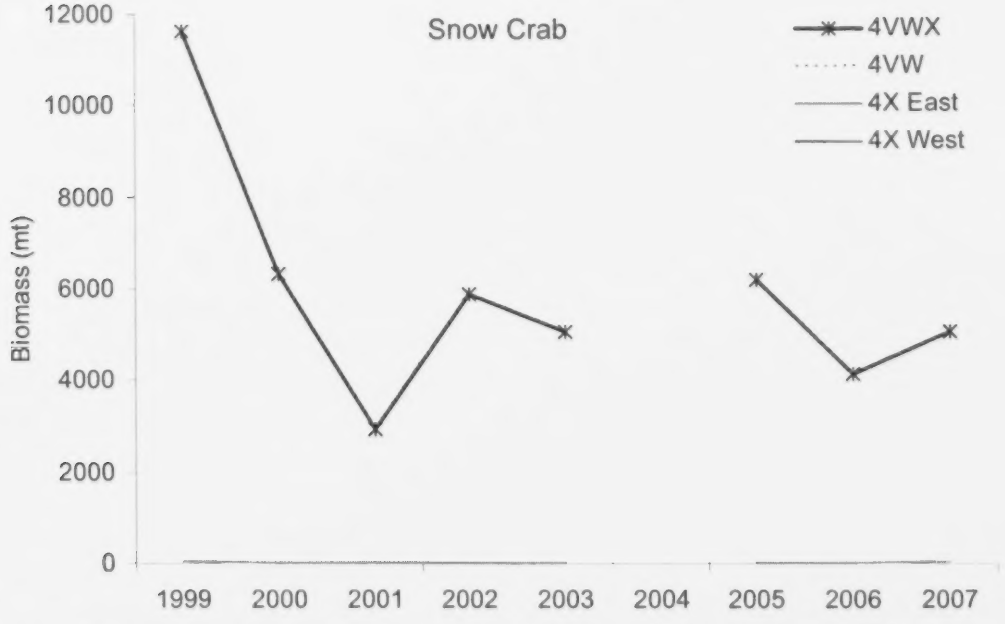

Figure 30b. Biomass estimate for snow crab from the Scotia-Fundy summer RV survey.

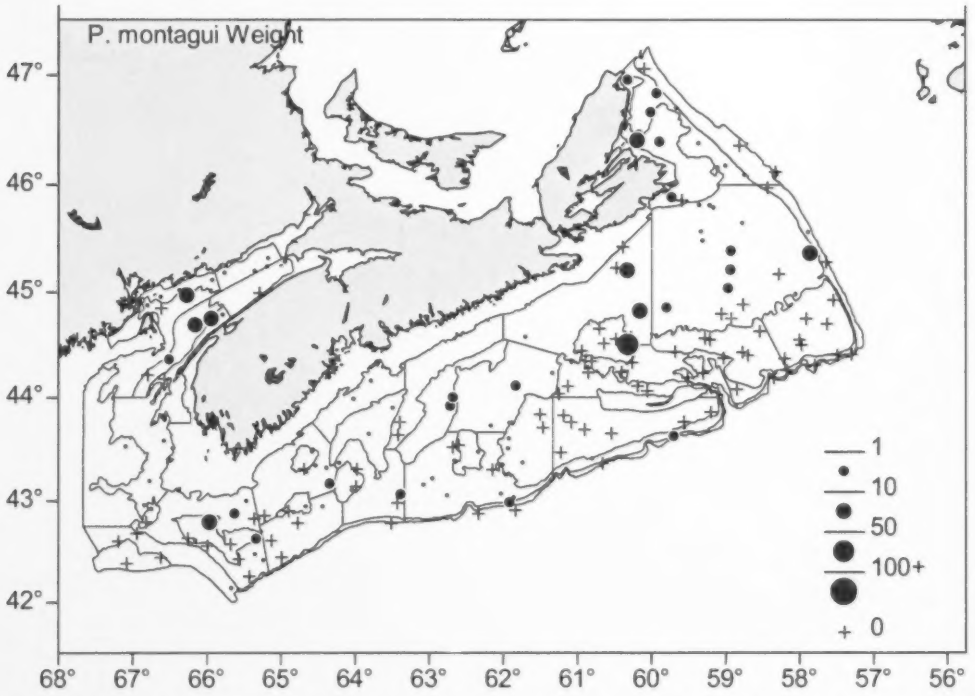

Figure 31. Distribution of *Pandalus montagui* (pink shrimp) catches during the 2007 Scotia-Fundy summer RV survey.

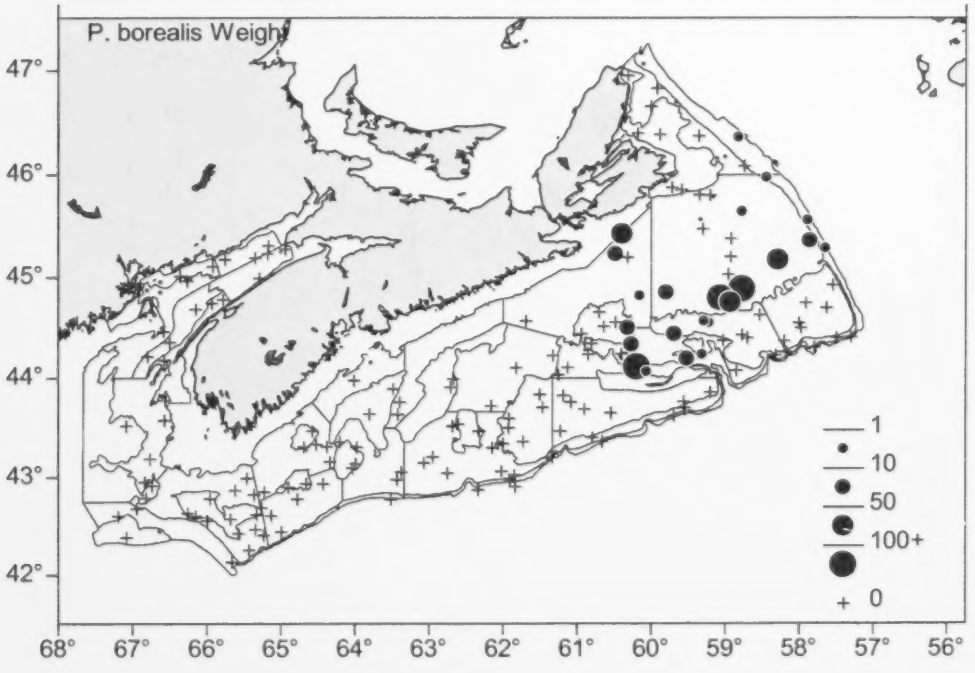

Figure 32. Distribution of *Pandalus borealis* (northern shrimp) catches during the 2007 Scotia-Fundy summer RV survey.

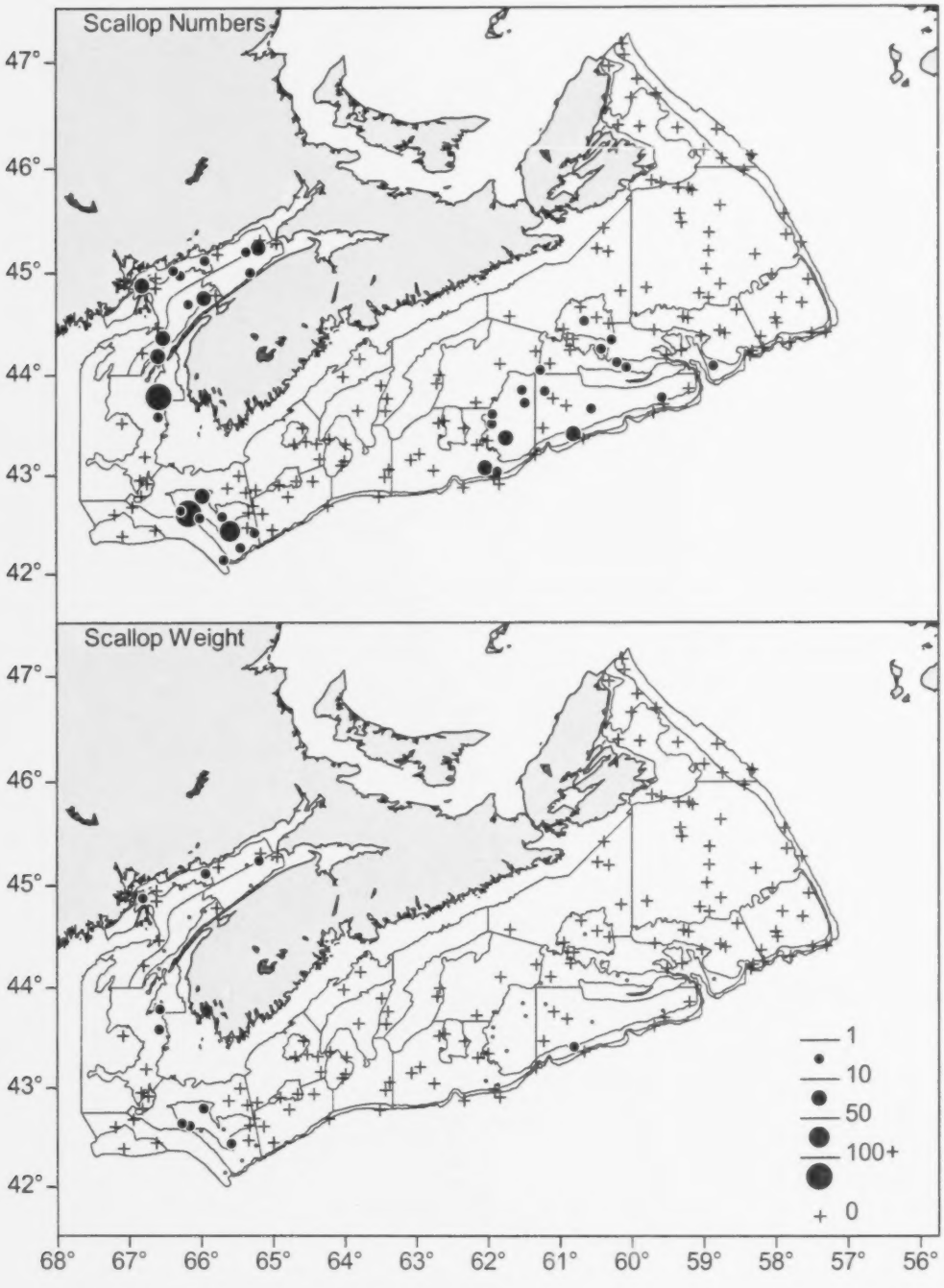

Figure 33a. Distribution of sea scallop catches during the 2007 Scotia-Fundy summer RV survey.

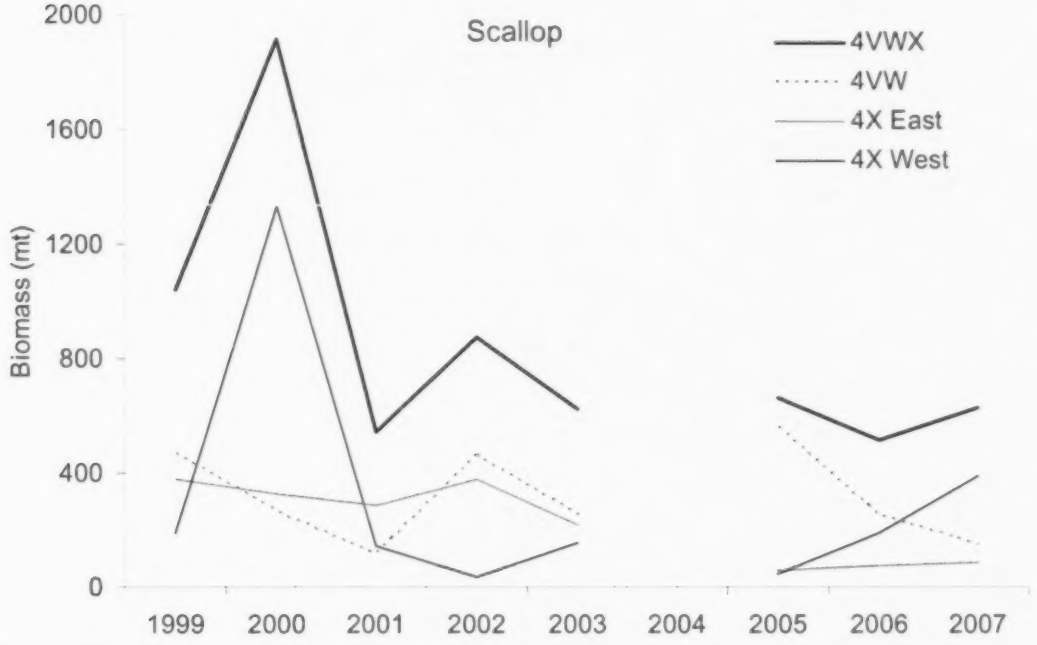

Figure 33b. Biomass estimate for sea scallop from the Scotia-Fundy summer RV survey.

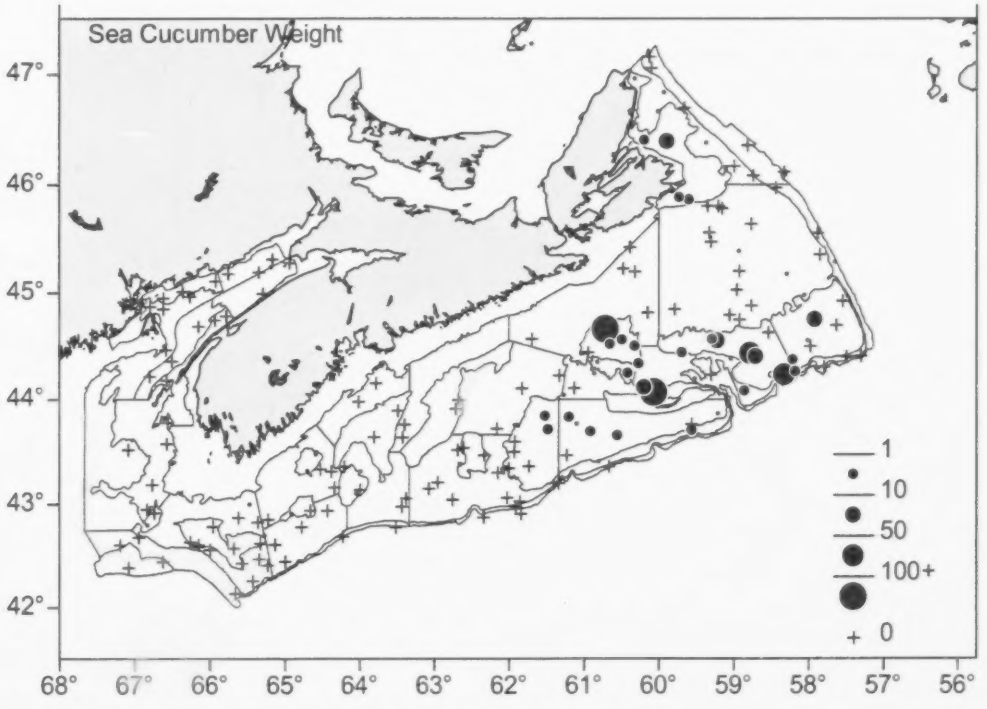

Figure 34. Distribution of sea cucumber catches during the 2007 Scotia-Fundy summer RV survey.

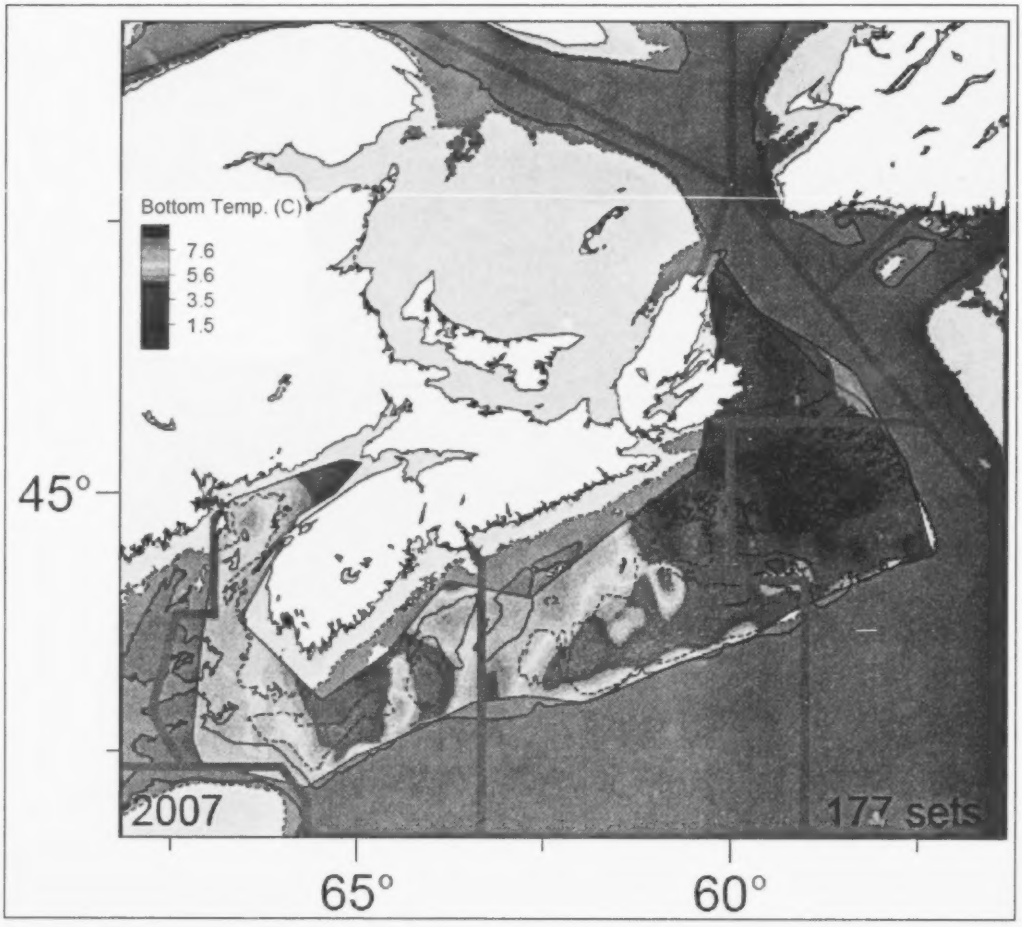

Figure 35a. Bottom temperature distribution from the 2007 Scotia-Fundy summer RV survey.

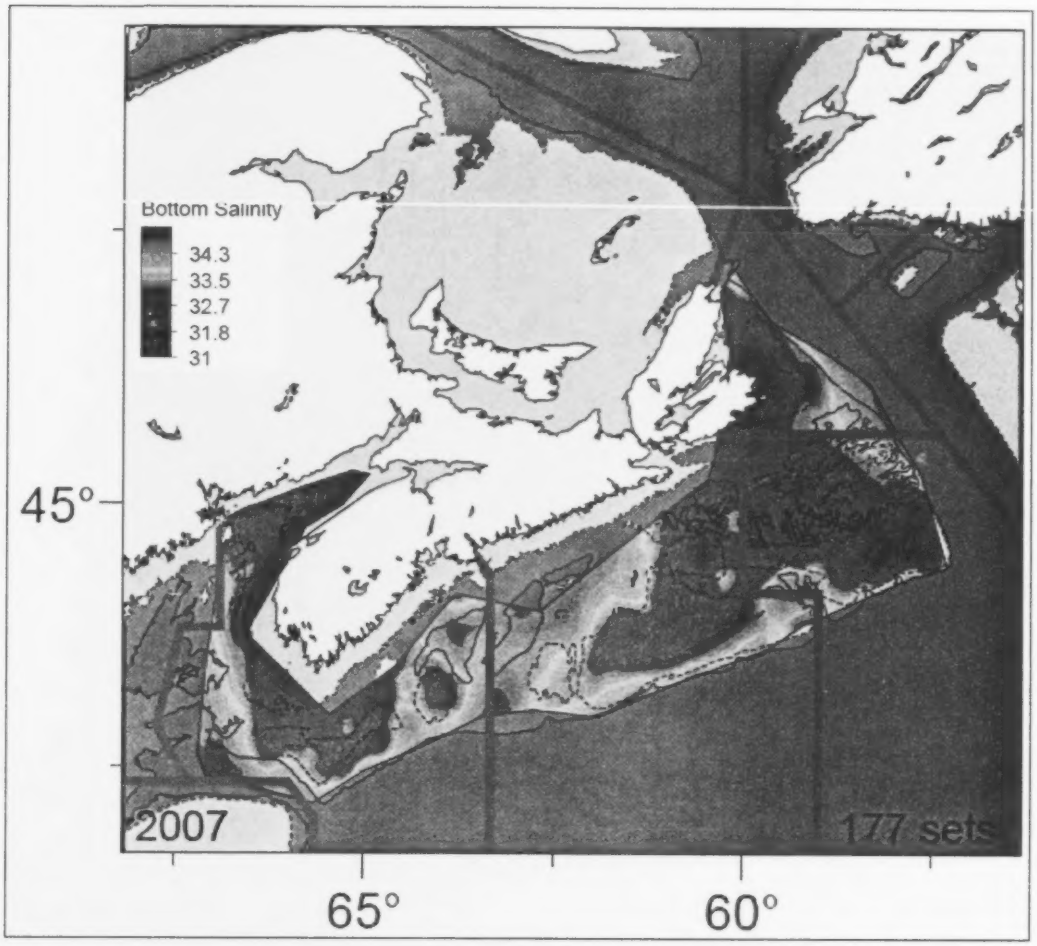

Figure 35b. Bottom salinity distribution from the 2007 Scotia-Fundy summer RV survey.